IN THE

Supreme Court of the United States

OCTOBER TERM, 1978

No. 78-1601

MANUFACTURERS SYSTEMS, INC.,
Petitioner,

vs.

ADM INDUSTRIES, INC., INDIANA TOOL & MFG. CO., INC., DREXELL (REX) L. SIMPSON, AND AMS OF INDIANA, INC.,
Respondents.

PETITION FOR WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE SEVENTH CIRCUIT

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TABLE OF CONTENTS

APPENDIX INDEX

(In This Volume)

TABLE OF AUTHORITIES

Cases:

Statutes:

IN THE

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Petitioner prays that a writ of certiorari issue to review the judgment of the United States Court of Appeals for the Seventh Circuit entered in this case on January 19, 1979.

CITATION TO OPINIONS BELOW

The District Court's opinion in this case is reported at 198 USPQ 223 (1978) and appears as Appendix A (p. 1) submitted with this petition, the opinion of the Court of Appeals is an Unpublished Order and appears as Appendix B (p. 82).

JURISDICTION

The jurisdiction of this Court is invoked under 28 U.S.C. 1254(1), as to the judgment by the Court of Appeals entered January 19, 1979.

QUESTIONS PRESENTED

The questions presented by this Petition are the following:

1. Whether the test of synergism has ever been a part of, or replaced the test of obviousness, in determining whether a new combination of old elements amounts to invention under 35 U.S.C. §103.

2. Whether the Appellate Court should not have applied the same interpretation of the test of synergism to the review of the District Court in this case as applied to another District Court case concurrently appealed and pending during this Appeal.

3. Whether the Appellate Court should not have granted a rehearing, or as suggested, a rehearing en banc, when a subsequent Appellate decision was rendered and published by three judges of the Appellate Court different than the three judges in this case who reached a different decision on the issue of synergism, but rendered it as an unpublished order.

4. Whether any secondary considerations should be considered in the statutory test of non-obviousness, until and unless, synergism is found.

5. Whether the Standard of Proof under 35 U.S.C. §102(a) and §103 are the same where evidence is primarily oral in carrying back the date of a third party invention.

STATUTES INVOLVED

§102 Conditions For Patentability—Novelty And Loss of Right to Patent—

A person shall be entitled to a patent unless—

(a) the invention was known or used by others in this country, or patented or described in a printed publication in this or a foreign country, before the invention thereof by the applicant for patent, or

(b) the invention was patented or described in a printed publication in this or a foreign country or in public use or on sale in this country, more than one year prior to the date of the application for patent in the United States, or * * *. 35 U.S.C. 102

§103 Conditions For Patentability; Nonobviousness Subject Matter

A patent may not be obtained though an invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived in the manner in which the invention was made. 35 U.S.C. 103.

STATEMENT OF THE CASE

Prior Proceedings

This is a patent infringement suit based upon Claim 8 of Patent No. 3,636,903, Claim 22 of Patent No. Re-28,-088, and Claim 4 of Patent No. 3,757,830.[1] The Defendants contended that the three patents in suit were invalid under 35 U.S.C. §103. Jurisdiction in the District Court was based upon 35 U.S.C. 271 and 28 U.S.C. 1338 and §1400(b).

After the bench trial, the District Court held each of the claims in suit to be invalid, and in reaching its decision, adopted verbatim and in toto, the 134 Findings of Fact, Conclusions of Law and Judgment Order proposed by Defendant ADM.

The Court of Appeals found the District Court's Finding of Fact not to be clearly erroneous, that the Court did not commit an error of law, and affirmed the opinion below without commenting about the synergistic test that the Court of Appeals had enumerated previously in *St. Regis Paper Co. v. Bemis*, 549 F.2d 833 (7 Cir., 1977).

MSI sought a Petition for Rehearing that included a Supplement subsequent to the Seventh Circuit's decision of *Republic Industries, Inc. v. Schlage Lock Co.* (1979) — F.2d —, (Appendix C, p. 97) that repudiated *St. Regis* (supra). MSI's Petition for Rehearing and suggestion that it be en banc, was denied on March 12, 1979.

THE '903 PATENT[2]

The '903 patent in suit (Sep. App. F. p. 138) relates

[1]Hereinafter referred to as the '903 "machine" patent, the '088 "method" patent, and the '830 "duct" patent.

[2]The specification and drawings are essentially identical for each of the three patents in suit.

to a machine for making heat duct automatically in which a pair of coiled metal sheets are passed through *an upper and lower* series of cooperating die and camming members that progressively work, crimp, and move the metal through the machine. The lock or seam portion of the two-piece duct is formed at the extreme edges of each sheet by passing them through the pairs of dies shown generally in Figures 3, 4 and 5. Upon reaching the stations in Figures 6, 7 and 8, the side portions of the duct are respectively cammed downwardly and upwardly by rotatably mounted rollers similar to a skate wheel but undriven. Examination of Figures 6 and 8 of the drawings discloses that the rollers, not in pairs, loosely engage the sheet of metal before encountering the lip portion or flange portions of the seam which is ultimately formed.[3] The final stations disclosed in Figures 9, 10 and 11 bring together the lock or seam portions into a tight-fitting relationship and the lock or seam is engaged by a plurality of tooth-like projections which pass directly opposite a recess in an opposing die to positively lock the elements of the seam or lock by offsetting the metal from one plane into another to prevent longitudinal or transverse movement of the upper and lower parts of the duct with respect to each other.

ARGUMENT

I.

THE SYNERGISTIC TEST

Before §103 came into being, the Court apparently for the first time suggested a synergistic test in *Great A & P Tea Co. v. Supermarket Equipment Corp.*, 340 U.S. 147 (1950), stating:

[3]See Columns 6, 7, lines 63-3 of the '903 patent, (Sep. App. F, p. 151, 152)

> "The conjunction or concert of unknown elements must contribute something; only when the whole in some way exceeds the sum of its parts is the accumulation of old devices patentable."

Next in the line of cases dealing with the question of patentable invention, came *Graham v. John Deere Co.*, 383 U.S. 1 (1966) in which §103, calling for strict observance of the obviousness standard was applied. Following *Graham* (supra) came *Anderson's-Black Rock v. Pavement Co.*, 396 U.S. 57 (1969) in which the Court enunciated that:

> "A combination of elements may result in an effect greater than the sum of the several effects taken separately. No such synergistic result is argued here."

However, the Court held that the combination of elements "was not an invention by the obvious-nonobviousness standard" i.d. at 63, the reference referring to §103 and the *Graham* case (supra). In *Sakraida v. Ag Pro, Inc.* 425 U.S. 273 (1976), the Court enumerated the requirements of the Constitution that there be "invention" to be entitled to patent protection and stated that the standard was enacted in 1952 by Congress in 35 U.S.C. §103. The Court, after first making reference to the Court of Appeal's holding that "although the flush system does not embrace a complicated technical improvement, it does achieve a synergistic result through a novel combination" (id. at 282), rejected that statement by stating:

> "We cannot agree that the combination of these old elements to produce an abrupt release of water directly on the barn floor from storage tanks or pools

> can properly be characterized as synergistic, that is, 'result[ing] in an effect greater than the sum of the several effects taken separately.' "

In *Dann v. Johnston*, 425 U.S. 219 (1976) decided three weeks prior to *Sakraida* (supra), the Brief of Petitioner and one of the amici urged that synergism was essential for patentability and that the patent did not possess synergism but the Court did not mention the word synergism any place in its decision. The entire case was decided exclusively under the nonobviousness theory.

For some reason or other, the various Courts of Appeals have improperly interpreted the Decisions of the Court and applied a synergistic test in some form as a measure of the patentability of an invention.

The Courts of Appeal have generally applied the synergistic test in finding a combination of old elements to be a patentable invention since *Sakraida* (supra) instead of the obviousness test of *Graham*. This was perhaps fostered and encouraged from the dissent in denying certiorari in *Roanwell Corp. v. Plantronics, Inc.* 429 U.S. 1004 (1976) wherein lies the statement:

> "Thus, to be patentable, the combination of elements must produce something more than the sum of the pre-existing elements; there must be a synergistic result that is itself nonobvious."

Many of the Appellate Courts since *Sakraida* and particularly since *Roanwell Corp.* have made the synergistic test a part of the requirement for patentability in finding a patentable combination of old elements. Since Sakraida,

the synergistic test has been followed in *International Telephone And Telegraph Corporation v. Raychem Corporation*, (1 Cir. 1976) 538 F.2d 453, —, cert. den. 191 USPQ 409; *Rosen et al v. Lawson-Hemphill, Inc.*, (1 Cir. 1976) 549 F.2d 205; *Digitronics Corp. v. The New York Racing Association, Inc.*, et al., (2 Cir. 1977) 553 F.2d 740; *U.S. Philips Corp. v. National Micronetics, Inc., et al.*, (2 Cir. 1977) 550 F.2d 716; *Systematic Tool And Machine Company et al. v. Walter Kidde & Company, Inc.*, (3 Cir. 1977) 555 F. 2d 342; *Aluminum Company of America, et al. v. Amerola Product Corporation et al.*, (3 Cir. 1977) 152 F.2d 1020; *Fred Witaker Company v. E. T. Barwick Industries, Inc.*, (5 Cir. 1977) 551 F.2d 622; *The Robbins Company v. Dresser Industries, Inc.*, (5 Cir. 1977) 554 F.2d 1289; *Reynolds Metal Company v. Acorn Building Components, Inc.*, (6 Cir. 1977) 548 F.2d 155; *Kearney & Trecker Corporation v. Cincinatti Milacron, Inc. et al.*, (6 Cir. 1977) 195 USPQ 402; *Pederson v. Stewart-Warner Corporation*, (7 Cir. 1976) 536 F.2d 1179; *Burland v. Trippe Manufacturing Company*, (7 Cir. 1976) 543 F.2d 588; *St. Regis Paper Company v. Bemis Company, Inc.*, (7 Cir. 1977) 549 F.2d 833; *Kamei-Autokomfort, et al. v. Eurasian Automotive Products*, (9 Cir. 1977) 553 F.2d 603; and *Rutter v. Williams* (10 Cir. 1976) 541 F.2d 878.

However, the Seventh Circuit in *Republic Industries, Inc. v. Schlage Lock Company* (Feb. 1, 1979) — F.2d — has taken the position that the Court at no time has abandoned the non-obvious test in favor of a synergistic test. Petitioner agrees that synergism is not a proper test for

patentability, but the District Court made Findings[4] that Petitioner's inventions did not satisfy the synergistic test and that "two plus two still equals four!"

Based upon the District Court's Findings (Appendix A, p. 68, 69), and Conclusions that there was no synergistic effect, pursuant to the law as set forth in the *St. Regis* case, the District Court never got to the question of obviousness. The Seventh Circuit analyzed such a fact situation in *Republic Industries*, stating:

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[4]111. More recently, since *Graham v. Deere, supra*, the Supreme Court has required closer scrutiny of patented "inventions" (whether machines, methods, or products) which constitute a collection of individually old elements or steps. If each element or step of such "inventions" performs only its known function, without "synergistic effect", that combination is unpatentable, *Anderson's-Black Rock, Inc. v. Pavement Salvage Co.*, 396 U.S. 57 (1969); *Sakraida v. Ag Pro, Inc.*, 425 U.S. 273 (1976). Our own Seventh Circuit Court of Appeals has made it clear that the Supreme Court's "synergism" test is to be applied to combination patents, stating that:

> "Section 103 cannot easily be satisfied by inventions that rearrange old elements in new combinations with each element performing the same function it performed in the prior art, even though the new combinations produces a more striking result than the old ones. . . . Unless the combination is "synergistic, that is 'result[ing] in an effect greater than the sum of the several effects taken separately'" it cannot be patented, *St. Regis Paper Co. v. Bemis*, 549 F 2d 833 (7th Cir. 1977).

The Court finds that all of the elements recited in asserted Claim 8 are old in the art, each performing its own function independently of others. Indeed, counsel for MSI admitted that he never specifically asked either one of MSI's experts about "synergism" (TT 1277-78). Neither reliance on the "free flow" method concept (*not* set forth in the '903 patent or any of its claims) nor reliance on "the steps that they took and the machine that they put together to produce that type of duct" satisfied MSI's burden of establishing "synergism" or a "synergistic effect" (TT 1277-78). Moreover, MSI has failed to adduce evidence in this record to establish the "synergism" required by the Supreme Court and the 7th Circuit Court of Appeals. The combination of elements recited in asserted Claim 8 does *not* produce a total greater than the sum of its parts—and does *not* produce a synergistic effect or result. In the case of asserted Claim 8, two plus two still equals four! Claim 8 is invalid for this reason.

" * * * one is required to look solely to the operation of the elements *after* they are combined. This analysis suffers from two defects. First, a test which looks exclusively to the functioning of the individual components after they are combined must necessarily be premised on the assumption that it is always obvious to take known elements and combine them. We find this assumption unsound and not based in fact.

* * *

The second and more basic defect with synergism is that §103 sets as the standard of patentability the nonobviousness of the invention 'at the time the invention was made to a person having ordinary skill in the art . . .' This provision therefore compels the courts to view the invention from the vantage point of the field of art at a specific point in time, i.e., the time the invention was made.

* * *

Synergism, however, precludes this analysis. Because synergism centers exclusively upon the performance of the elements *after* combination and without regard to the obviousness or nonobviousness of *making the combination*, synergism does not comport with the Graham mandate to apply Section 103."

Examination of the findings of the District Court do indeed show that the District Court, in following what it thought was the proper test pursuant to *St. Regis* found (fn. 4, supra) that MSI had failed to adduce evidence in the record to establish the synergism required by the Supreme Court and Seventh Circuit Court of Appeals rather than applying the test of nonobviousness for the sine qua non of patentable invention and that simply is not the proper test.

II.

APPELLATE REVIEW

On June 5, 1978, the Seventh Circuit heard arguments in another case, *Republic Industries, Inc. v. Schlage Lock Company*, — F.2d — (Appendix C, p. 97) that was decided February 1, 1979, in which the Court of Appeals acknowledged that the:

> "[A]ppeal presents a recurrent problem: the proper criteria by which a combination patent is measured for nonobviousness. Increasingly, the district courts in this circuit, not without some confusion emanating from this court, have taken the view that synergism and not the criteria articulated in *Graham v. John Deere Co.*, 383 U.S. 1 (1966), is the controlling test in combination patent claims."

The Seventh Circuit reviewed the cases of the Court in historical context since *Graham*, including *Anderson's-Black Rock v. Pavement Co.*, 396 U.S. 57 (1969) and *Sakraida v. Ag Pro, Inc.*, 425 U.S. 273 (1976) and found that synergism was neither a substitute for, nor an addition to, the statutory requirement of nonobviousness as interpreted in *Graham*. The Seventh Circuit reasoned that the *Graham* case called for "strict observance" of the requirements of the obviousness standard under §103, and stated:

> "It is against this backdrop that *Blackrock* and *Sakraida* must be read.
>
> * * *

Neither *Sakraida* nor *Black Rock* can be cited as prescribing some other, special test for the evaluation of com-

bination claims. Nowhere in these two decisions did the Court hold a synergistic effect to be a necessary condition of patentability; nor did it hold that synergism supersedes a finding of nonobviousness under the *Graham* analysis. To the contrary, each case quoted *Graham* with approval. Each turned on whether the claimed invention was nonobvious on the basis of the three-pronged test in *Graham*. In short, we believe that *Sakraida* and *Black Rock*, rather than establishing an additional, different, or substituted test for nonobviousness under section 103, reaffirmed the continuing vitality of *Graham*.

* * *

Courts have long wrestled with the meaning of synergism and have formulated a number of definitions. The two most common have been that one of the elements functions differently in combination than it did previously, *e.g., Burland v. Trippe Manufacturing Co.*, 543 F.2d 588, 592 (7th Cir. 1976), and that the combination results in an effect greater than the sum of the several parts taken separately. *E.g., St. Regis Paper Co. v. Bemis Co.*, 549 F.2d 833, 838 (7th Cir.), *cert. denied*, 434 U.S. 833 (1977).* A realistic appraisal of these formulations, however, reveals that synergism is only a figure of speech, for in its literal sense synergism never has existed and never can exist in mechanical or hydraulic inventions when the term is defined as a whole result greater than the sum of its constituent parts.*

There is, in fact, no such thing as a mechanical or hydraulic element functioning differently in combination than it did outside the combination. A spring or valve

*The footnote is omitted.

will always function as a spring or valve, alone or in concert with other components.[5]

* * *

Today, almost all mechanical devices consist of parts which interact with each other. This interaction has little, if anything, to do with the required nonobviousness of the claimed invention. Although the absence of interaction may demonstrate the obviousness of the combination, the presence of interaction assuredly does not impart nonobviousness to a device clearly suggested by the prior art. As thus defined, synergism is simply too broad to provide a useful yardstick with which to measure patentability.

Putting the definitional aspects aside, there are more fundamental flaws in the use of synergism as a standard for patentability. In enacting section 103, Congress expressly mandated nonobviousness, not synergism, as the sole test for the patentability of novel and useful inventions: indeed, synergism is not even mentioned in the Patent Act of 1952. Moreover, as section 103 applies to all patent claims, there is no justification why patentability of a combination patent should be measured by a different standard than any other type of invention.

* * *

It may be that in certain circumstances the very choice of the elements to be selected is not obvious. Again, as Judge Hand noted:

> All machines are made up of the same elements: rods, pawls, pitmans, journals, toggles, gears, cams,

[5](Cited in the case as f.n. 22) Assuming *arguendo* that there exists an exception, the new function should nevertheless not be a *sine qua non* to a finding of patentability, but merely be taken as evidence to be considered along with other evidence available to the obvious-nonobvious inquiry.

> and the like, all acting their parts as they always do and always must. All compositions are made of the same substances, retaining their fixed chemical properties. But the elements are capable of an infinity of permutations and the selection of that group which proves serviceable to a given need may require a high degree of originality. *It is that act of selection which is the invention* . . . .

B.G. Corp. v. Walter Kidde & Co., 79 F.2d 20, 22 (2d Cir. 1935) (emphasis added). *See also Application of Menough*, 323 F.2d 1011, 1015 (C.C.P.A. 1963).

* * *

From this vantage point the critical question becomes whether the level of skill in the art was such that the combining of the elements in the manner claimed would have been obvious, not in retrospect, but at the time it was done by the inventor. As the Supreme Court stated in *United States v. Adams*, 383 U.S. 39, 50 (1966), a companion case to *Graham:*

> It begs the questions . . . to state merely that magnesium and cuprous chloride were individually known battery components. If such a combination is novel, the issue is whether bringing them together as taught by [the inventor] was obvious in the light of the prior art.
>
> * * *

Regrettably, we have heretofore failed to provide clear and consistent guidance regarding the standards appropriate for combination patents. Although we have in fact continued, either explicitly or implicitly, to judge patent validity according to the *Graham* analysis, we have also from time to time commented on the presence or absence

of a requirement akin to synergism in the claimed invention under review. And in *St. Regis, we stated our conclusion in such a way that it may seem that we regard synergism as a test separate from and coequal to that for non-obviousness under section 103.* Inasmuch as *Graham* and section 103 continued to be the guiding light, the results of those cases were not in error. But as the foregoing discussion makes evident, this court never intended that synergism be applied literally or that synergism is the *sine qua non* of patentability." [Emphasis added]

A review of the District Court cases[6] since *St. Regis* suggests that their interpretation of the Seventh Circuit's requirement for synergism goes much further than the marker on the synergistic track enumerated "it may seem." One of those cases, *Saunders v. Air-Flo Company*, 435 F. Supp. 298 (N.D. Ind. 1977) was decided by the same District Court that tried this case, where a synergistic track had been established.[7]

What the Court of Appeals said earlier in *St. Regis*, was made a part of the Findings and Conclusions of the District Court.[8] However, in the Appellate review of this case, the Court heard arguments November 6, 1978 and ren-

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[6] *See, e.g., A. F. Dormeyer Manufacturing Co. v. International Components Corp.*, (No. 76 C 2134) (N.D. Ill., June 8, 1978); *Harig Products, Inc., v. K. O. Lee Co.*, 195 U.S. P.Q. 292 (N.D. Ill. 1977); *Saunders v Air-Flo Company*, 435 F. Supp. 298 (N.D. Ind. 1977); *Republic Industries, Inc. v. Schlage Lock Co.*, 433 F.Supp. 666 (S.D. Ill. 1977).

[7] "Sakraida and St. Regis Paper represent the last word on this subject from the Supreme Court and our own Court of Appeals. It is the view of this Court that they compel the result reached here as to validity. Absent this compulsion this Court might be inclined to decide the validity issue differently than here announced.

* * * *

There is no evidence in this case answering any synergistic effect." (Saunders v. Air-Flo Co. [supra])

[8] Findings F-111, 121, 122, 128, 129—Appendix A, p. 68, 74, 77.

dered its Decision January 19, 1979, but nowhere in its decision does any discussion arise relating to the test of synergism, notwithstanding that the trial Court's Findings and Conclusions are grounded upon the *St. Regis* case in which the same judges of the Seventh Circuit subsequently severely criticized the rules of their own making in *Republic Industries.* The Appellate decision of this case was then summarily relegated to the dark and unpublished archives of the Seventh Circuit, never to be used again, except under special circumstances.[9]

The Seventh Circuit Court of Appeals has applied the law of the *St. Regis* case in this appeal in a manner diametrically opposed to that of the *Republic* case. The Court has consistently held from as early as the *United States v. Scooner Peggy,* 1 Cranch (U.S.) 103, 2 L.Ed. 49 (1801) that:

> "It is in the general true that the province of an appellate court is only to inquire whether a judgement when rendered was erroneous or not. But if, subsequent to the judgment, and before the decision of the appellate court, a law intervenes and positively changes the rule which governs, the law must be obeyed, or its obligation denied.
>
> * * *
>
> [I]f it be necessary to set aside a judgment, rightful when rendered, but which cannot be affirmed but in violation of law, the judgment must be set aside."

It would seem elementary that if the change were brought about by the Appellate Court itself, and the decisions were pending at the same time, both cases under review should have been treated uniformly. The Appel-

[9]Circuit Rule 35 (see Appendix D, p. 121).

late Court in *Republic* purports not to overrule *St. Regis,* but merely repudiates the apparent holding. If this is true, there is no question that the rationale of *Republic* should be applied to MSI because *Republic* merely clarifies what the Seventh Circuit interpreted the law to be all along. However, *Republic* should be realistically characterized as overruling *St. Regis* and be given a retroactive effect. Thus it is apparent that the Seventh Circuit had a chance to remedy the ruling of the District Court in this case and for some unknown reason, permitted an erroneous application of the law.

III.

THE PETITION FOR REHEARING

The Appellant sought a Petition For Rehearing and suggested it be en banc which was filed before the Court on February 8, 1979. Appellant was unaware that the *Republic* case was decided February 1, 1979 until after the filing of its Petition For Rehearing. Subsequently, on February 16, 1979, Appellant sought leave to file a Supplement to the Petition For Rehearing. Appellant's Petition For Rehearing was denied, the Order stating:

> "On consideration of the Petition for Rehearing filed in the above-entitled cause by Plaintiff-Appellant, Manufacturers Systems, Inc., all of the judges on the original panel having voted to deny the same,
>
> IT IS HEREBY ORDERED that the aforesaid petition for rehearing, as supplemented, be, and the same is hereby, DENIED."

No reference was made to the suggestion that the Rehearing be en banc nor that the suggestion was transmitted

to the judges of the Court who are in regular active service, nor that the judges in regular active service had not voted to grant such a rehearing en banc.

Thus the result is that three judges repudiated the *St. Regis* holding and published the decision of the *Republic* case while three other judges of the same Appellate Court made a concurrent deliberation and let the holding of the *St. Regis* case stand, but relegated the decision in this case to an unpublished place in the archives.

The Appellate Court had a duty not to continue the confusion they admitted they had created over the issue of synergism and having once repudiated the *St. Regis* case, Petitioner's case was clearly one of *sub judice* entitled to the same holding.

IV.

THE SECONDARY CONSIDERATIONS UNDER SECTION 103 WERE MOST LIKELY DROPPED BY THE SYNERGISTIC DETERMINATION.

It is clear the Trial Court first made the determination that Claim 8 of the '903 "machine" patent was invalid as a matter of law (having determined that MSI did not satisfy the synergistic requirements of the Supreme Court and the Seventh Circuit decision of St. Regis) and then concluded that it need not give consideration to the secondary considerations listed by the Court in *Graham*. However, the Seventh Circuit in *Republic Industries* reasoned that after a trial court determined there was no synergism, it was wrong to drop the secondary considerations. The District Court had before it a number of outstanding examples of secondary considerations, not the least of

which was its own Finding[10] of intentional copying[11] and evidence of extraordinary commercial success.[12] Those secondary considerations should not have been ignored. Section 103, in its context, or in the congressional proceedings leading up to the codification of the law, has never suggested that synergism played any part of its determination.

V.

STANDARD OF PROOF UNDER §§103 AND 102(a)

The District Court found (Finding 45, Appendix A, p. 28) that the Seventh Circuit had determined the standard of proof under 35 U.S.C. §102 is one of clear and convincing evidence and that the same standard for establishing obviousness under 35 U.S.C. §103 is to be applied. The Trial Court further found (Finding 46, Appendix A, p. 28) that the clear and convincing standard may be established by oral testimony alone. The cases cited by the District Court all deal with the standard of proof required under §102(b) and not §102(a). The Court of Appeals approved the Findings of the District Court and held that under such a standard of proof, a third party machine known as the Vulcan machine,[13] was prior art. However, the District Court and the Appellate Court should not have been dealing with the standard of proof under §102 (b) because as the Seventh Circuit earlier stated in the case of *Illinois Tool Works, Inc v. Solo Cup Company, Inc.*,

[10](Finding 115, Appendix A, p. 71).
[11]Plaintiff's Trial Exhibit PX 56 (Sep. App. J, p. 175)
[12]Plaintiff's Trial Exhibit PX 42 (Sep. App. J, p. 176).
[13]Appendix G, p. 158. [Defendants' Trial Exhibit DX XFA and Deposition Exhibits DDX 89-93.]

461 F.2d 265 (1972), in adopting the decision of an earlier District Court decision:

> "*Once the year in which to prepare and file his application had passed,* the employment of a standard of patentability less stringent against the first inventor than against others would seem to impair, if not defeat congressional policy. There should be no distinction between prior art of the inventor's own making and that of others." [Emphasis added]

There can be no question that §102(b) does not apply where the one year period has clearly not passed. MSI reduced its machine to practice on December 13, 1969 (Finding No. 8, Appendix A, p. 5) and the first application for patent was filed on February 19, 1970 (Finding No. 10, Appendix A, p. 6), and thus §102(b) was not an issue. What is even more puzzling and disturbing is that the Trial Court by an Order filed November 4, 1977 (dated October 26, 1977) set aside the defense of 35 U.S.C. §102(b), Defendants admitting there were no defenses under that sub-section.

It makes no difference whether the patentee is carrying back his own invention, or a supposed infringer is carrying back his, the burden of proof is the same as the burden of proof necessary to establish a prior use where the patentee filed his application within the statutory period. The difference between §§102(a) and 102(b) is rather basic. Section 102(a) makes it imperative that the inventor claiming under the Act be the *first* inventor of the claimed subject matter, as well as the subject matter being in itself a novel and original advance.

Section 102(b) imposes the time limitation of one year

on the inventor which limitation is recognized by Congress as implied in the Constitution that an inventor act with deliberate speed in filing his patent application, or his rights to a legal monopoly will be statutorily barred.

Of course, §§102(a) and 102(b) do not involve the same tests and reference points generally as to invalidity. Section 102(a) directs the inquiry to a prior use or knowledge of others in this country at any time before the patent applicant's *date of invention*. Section 102(b) directs inquiry to a public use or a placing on sale in this country more than one year prior to the *date of application* which was not involved here.

In the instant case, because MSI filed its application within the one year bar established by §102(b), there is no reason to employ a standard of proof less stringent than proof beyond a reasonable doubt to overcome the *date of invention* as first established by this Court in *Coffin v. Ogden,* 18 Wall 120 (1874). In *Cantrell v. Wallick,* 117 U.S. 689 (1886), the Court reiterated the test and in the case of *The Barbed Wire Patent,* 143 U.S. 275 (1892) in dealing with proof by oral testimony held that:

> "[C]ourts have not only imposed upon defendants the burden of proving such devices, but have required that the proof shall be clear, satisfactory and beyond a reasonable doubt."

That same standard was again applied in *Deering v. Winona Harvester Works,* 155 U.S. 286 (1894) where the Court said:

> "This case in an apt illustration of the rule requiring such anticipations to be proven by evidence so cogent as to leave no reasonable doubt in the mind of

the court, that the transaction occurred substantially as stated." Id. at 301.

The Seventh Circuit in its affirmation of the District Court in this case relied upon the case of *National Rolled Thread Die Co. v. E. W. Ferry Screw Products, Inc.*, (6 Cir., 1976) 541 F.2d 593, 596, to support its contention that there was no reason to differentiate between the standard of proof under §102(a) and §102(b). However, the footnote at the bottom of page 596 relegates the Sixth Circuit decision to the same category as that expressed in the *Illinois Tool Works, Inc.* (supra) because the prior art mechanisms in the form of dies were publicly known and were " * * * publicly used more than one year before National filed the original patent application (35 U.S.C. §102(b))." The fact situations in the Sixth Circuit case and the Seventh Circuit case of *Illinois Tool Works* were similar where a standard of proof less stringent than that in the instant case took place because the patentee had lost his rights as determined by §102(b). ***That is not the fact situation in this case,*** and thus a higher degree of proof is required relative to the Vulcan machine to invalidate the patents in suit.

In the instant case, there was an acute conflict in the testimony[14] between Mr. Watts and Mr. Ashley in attempting to prove the prior art status of the Vulcan machine, method, and product.

[14]The deposition testimony of Ashley and Watts conflict on at least the following points in attempting to establish any prior art use of the Vulcan machine, method and product:

A. Ashley was present during testing of the Vulcan machine in June '69 and testified it was jogged or operated for only a minute or so (Appendix E, p. 130, 131), while Watts knew only of a product and indicated there were test pieces of samples (Appendix E, p. 124).

B. Ashley stated the heat treated rolls removed from the frame were not put in the frame until November, 1969 (Appendix E, p. 134, 135). However, Watts said that the machine was ready to produce a product for sale in September, 1969, even though he had nothing to do with setting the rolls or dies and that no company records existed to show putting any product into inventory in September, 1969 (Appendix E, p. 124, 125, 126).

C. At the critical time, Ashley set 1" x 1" rolls in the frame in December, 1969 or January, 1970 (Appendix E, p. 132) while Watts stated the double mullion (2" x 2") rolls were set December 29 and 30, 1969 (Appendix E, p. 126 and Appendix K, p. 177 [PDX-150])

D. Watts knew of no company documents earlier than the sales memorandum dated February 4, 1970 describing the new Vulcan product (Appendix E, p. 130 and Appendix K, p. 178-180 [PDX-151]), which was almost two months after the critical date.

Ashley and Watts confirm each other generally in establishing a lack of records:

E. No records exist of the conception date of the machine (Appendix E, p. 129, 134).

F. No drawings were prepared by either witness (Appendix E, p. 129, 135).

G. There are no documents to establish when the heat treated rolls were placed in the frame forming the Vulcan machine (Appendix E, p. 128, 134).

The evidence presented to the District Court, which was primarily oral, was not sufficient to meet the burden of proof requiring the evidence to be so cogent as to leave no reasonable doubt, and thus the Vulcan machine, method and product should not be found to be prior art.

While considering Claim 8 of the '903 patent, the District Court found the Vulcan machine was prior art under the clear and convincing standard of proof, but it failed to find that the Wogerbauer patent (Appendix H, p. 163) include any elongated fixed die member of Claim 8 (Appendix A, p. 34) and it failed to find the Lockformer machine (Appendix I, p. 173) worked two pieces of metal, finding only that the Lockformer machine produced a U-

shaped clip from a single blank of metal which was not continuously formed and was of a non-rectangular channel configuration (Appendix A, p. 35). ADM's only courtroom witness, Mr. Tucker, couldn't describe how two Lockformer machines could somehow be put together to form a piece of duct and when asked if he thought it was possible, he said: "It would be very difficult." (Appendix E, p. 136 [R-677, 678].

Under Section 103, the District Court applied "hindsight" in arriving at a combination of Vulcan and Lockformer Cliprol machines and methods of operation *because not a single witness testified on how the two machines could be combined.* This Court in *Graham, v. John Deere Co.,* (supra) cautioned against falling into the trap of hindsight and finding an invention once disclosed, obvious, i.d. at p. 36.

The Court found it was within the province of one having ordinary skill in the roll-forming or metal bending machine art to combine the Lockformer-type fixed die member and cooperative camming members with the Wogerbauer-type machine and that the combination would have been obvious in June of 1969 (F 104, 107).[15] The Court also found that the Wogerbauer patent discloses the subject matter of Claim 1 of the '903 patent. (F 78)[16]

On cross-examination, Mr. Tucker, using hindsight, said he would use the teachings of the MSI machine to make the Wogerbauer machine workable.[17] If the Wogerbauer structure had to be modified in the light of the patents in suit and the Vulcan machine was not available

[15]Appendix A, p. 64, 65.
[16]Appendix A, p. 48.
[17]Appendix E, p. 136, 137. [R 704-706].

as prior art, ADM had no first line of defense and the inventions clearly took on the criteria of "non-obviousness."

CONCLUSION

Petitioner submits that the District Court erred in applying the synergistic test of the *St. Regis* case as the sine qua non for patentable invention. The Seventh Circuit Court of Appeals compounded that error by permitting the District Court's decision to stand when appealed while concurrently repudiating its earlier *St. Regis* decision in the *Republic Industries* case.

For the foregoing reasons, the Petition For Writ of Certiorari should be granted.

Respectfully submitted,

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APPENDIX

APPENDIX-A

IN THE
DISTRICT COURT FOR THE NORTHERN DISTRICT
OF
INDIANA, SOUTH BEND DIV.

MANUFACTURERS SYSTEMS, INC.
v.
ADM INDUSTRIES, INC., ET AL.
No. 72 S 102

DECIDED FEB. 16, 1978

AS AMENDED FEB. 22, 1978

(198 USPQ 233)

Memorandum

Following a six-day trial of this case to the Court, the parties requested and received time to review the transcript of the trial and then to submit proposed Findings of Fact and Conclusions of Law. These proposals proved to be very detailed and very extensive. (Plaintiff's proposals totaled 78 pages and defendants' were of equal length.) These proposed findings and conclusions were exchanged by counsel and each side given an additional period of ten days to object to all or any portion thereof as to form. No objections or corrections were suggested.

Subsequent thereto the Court has had further opportunity to review the evidence and the record as a whole. The issue of infringement was not contested by the defendants except for reliance upon the principle that invalid patents cannot be infringed. For reasons more particularly set forth below, we find that the plaintiff's patents in suit are valid for obviousness, under 35 U.S.C. § 103. Because of our determination that the asserted claims of the patent in suit are invalid, we deem the issue of unenforceability, based upon plaintiff's alleged misuse of the patents, to be moot.

Having concluded that this Court's findings must be against the plaintiff, we have thoroughly and carefully

studied and considered the findings submitted by the defendants. Both sides' findings were written with an expertise in the area of patent law that this Court would find difficult to equal—much less improve upon.

Inasmuch as we are satisfied that the proposals as submitted by the defendants do well and accurately express the findings and conclusions of the Court, we now adopt them as our own and do hereby enter the following Findings of Fact and Conclusions of Law.

Findings of Fact and Conclusions of Law

Introduction

1. This is a civil action by which plaintiff (hereinafter MSI) charges defendants with: (1) infringement of U. S. Patent No. 3,636,903, entitled "Rectangular Duct-Forming Machine"; (2) infringement of U. S. Patent No. Re. 28,088, entitled "Method of Forming A Rectangular Heat Duck", and (3) infringement of U. S. Patent No. 3,757,-830, entitled "Rectangular Air Duct".[1] Defendants contend that: (1) the three patents in suit are invalid under 35 USC §103; (2) the three patents in suit are not infringed because invalid patents cannot be infringed; and (3) the three patents in suit are unenforceable because of MSI's patent misuse and unclean hands.

2. MSI is a Minnesota corporation having as two of its principal shareholders Leroy E. Anderson and Gerold J. Munn, who jointly developed the subject matter of the '903, '088, and '830 patents in suit. MSI's wholly owned

[1]Hereinafter referred to as the '903 "machine" patent, the '088 "method" patent, and the '830 "duct" patent.

subsidiary, Snappy, Inc., manufactures duct-forming machines which MSI and its representative, Trade Names, Inc., lease to mobile home manufacturers. These manufacturers used the leased machines to produce heating ducts for mobile homes.

3. Defendant ADM Industries, Inc., is an Indiana corporation and was a component supplier to the mobile home industry. It also leased duct-forming machines to mobile home manufacturers. Defendant AMS of Indiana is an Indiana corporation and acquired that part of the assets of ADM Industries relating to the mobile home industry. Defendant Drexell L. Simpson was the President of ADM Industries, Inc., and is now the President of AMS of Indiana. Defendant Indiana Tool & Mfg. Co., Inc., is the manufacturer of the ADM Industries' second form of duct-forming machines.

4. The Court has subject matter and *in personum* jurisdiction, and venue is proper before this Court.

The Development of MSI's Duct-Forming Machine

5. Prior to the development of the duct-forming machine described in the '903 "machine" patent, Mr. Leroy Anderson and Mr. Gerald Munn were both employed by Snappy, Inc. They produced a line of pipe and duct fittings and virtually a complete line of products needed by installers for producing heating, ventilating, or air conditioning systems, principally in residential construction (TT 72).

6. In 1969, Mr. Gerald Munn joined Snappy as a salesman and in that capacity visited several mobile home manufacturers with a view toward involving Snappy in the

sale of heating duct to mobile home manufacturers (TT 201). Mr. Munn observed the way in which the mobile home manufacturers used and installed heating and ventilating ducts in mobile homes (TT 202).

7. Thereafter, Mr. Munn conceived the idea of developing a portable machine into which would be fed two sheets of aluminum that would be formed continuously into a rectangular-shaped duct. The length of the duct would only be limited by the length of the aluminum sheets fed into the machine (TT 205). The original concept of Mr. Munn's duct-forming machine is illustrated in his sketch identified as Plaintiff's Exhibit 11 and was shown to Mr. Anderson on July 14, 1969 (TT 87). Mr. Munn's duct-forming machine was never built, because Mr. Anderson perceived certain problems with the proposed machine (TT 97).

8. Mr. Anderson then modified Mr. Munn's concept, but even Mr. Anderson's modifications did not produce an operable machine. The material fed through the modified machine was torn and it jammed (TT 122). Indeed, this prototype duct-forming machine was abandoned because metal was jamming at Station No. 4, one of several stations at which the metal was progressively worked (TT 128). A prototype duct-forming machine which overcame the previous tearing and jamming problems was finally completed and duct was first run on this prototype machine on December 13, 1969 (TT 137).

9. A production-type machine was completed in late April of 1970. In April or early May of 1970, the production-type machine was taken to Trade Names, Inc., in Elkhart, Indiana, for a demonstration (TT 141). As a result,

MSI and Trade Names entered into an agreement (PX-12) whereby Trade Names agreed to act as MSI's representative in leasing the duct-forming machine to mobile home manufacturers (TT 144).

The '903 "Machine" Patent In Suit

10. The '903 "machine" patent is entitled "Rectangular-Duct Forming Machine" and was issued on January 25, 1972, based on an application filed on February 19, 1970 (PX-1). It is assigned on its face to Snappy, Inc., and was subsequently assigned to MSI (PX-2A). The '903 "machine" patent describes and illustrates a machine for continuously shaping and forming two separate sheets of metal into a rectangular-shaped duct. The machine has a frame, which carries *two* separate series of successive pairs of cooperative rotary dies that engage and progressively form two separate sheets into a rectangular shape. The two sheets are joined together to form a rectangular-shaped duct (PX-1).

11. More specifically, the '903 "machine" patent illustrates and describes two separate metal sheets passing through the duct-forming machine along separate paths (i.e, one path located above the other path). One series of cooperative rotary dies engages and shapes the first piece of sheet metal, while the second series of rotary dies engages and shapes the second piece of sheet metal. The two pieces of sheet metal are then formed around a fixed die member (mandrel) under the control of a plurality of rotary camming members. The lateral edges of the two pieces of sheet metal are then joined together to form a rectangular-shaped duct having sidewardly extending seams (i.e., a side-seam duct) (PX-1).

12. The '903 "machine" patent was issued with 32 claims (PX-1). Of these, MSI asserts only Claim 8 which is a relatively narrow claim dependent from Claim 1 (PX-1). Hence, asserted Claim 8 includes all of the subject matter recited in both Claims 1 and 8, as set forth below:

> "1. A rectangular heat duct former capable of continuously forming a rectangular duct of conventional heat duct cross-sectional dimensions and of any appreciable length from pairs of rectangular sheets of metal, limited only by the length of such sheets, as they pass therethrough, comprising:
>
> a. an elongated frame, and
>
> b. rectangular duct-forming mechanism carried by said frame and constructed and arranged to continuously form in progressive stages ducts which have rectangular heat duct cross-sectional dimensions and configuration from pairs of such rectangular sheets of metal as they pass through said mechanism including:
>
> 1. two series of successive pairs of cooperative rotary die members
>
> 2. each of said series being disposed along one of a pair of spaced metal-sheet paths extending longitudinally of said frame,
>
> 3. said pairs of cooperative rotary die members of each of said series being mounted for rotation upon said frame at spaced locations along the length of said frame and being constructed and arranged to engage the lateral portions of such sheets

at each side thereof to cooperatively and progressively shape each of such pairs of sheets into an elongated rectangular duct as they pass longitudinally through said mechanism,

4. some of said pairs of cooperative rotary die members being also disposed at locations spaced transversely of said frame at opposite sides of such sheets in position to engage them at their lateral portions as they pass through said mechanism, and

5. progression means supported adjacent said series of rotary die members and constructed and arranged to engage and move a pair of such sheets of metal longitudinally through said mechanism in spaced relation to each other and in position to be engaged at their lateral portions and so shaped by said cooperative rotary die members."

"8. The structure defined in Claim 1, wherein said duct-forming mechanism also includes:

6. a fixed die member carried by said frame and extending longitudinally thereof, and

7. a plurality of camming members mounted on said frame adjacent said fixed die member and constructed and arranged with respect thereto to engage and cooperatively shape lateral portions of such sheets as the latter pass longitudinally

through said mechanism and thereby form such sheets progressively along their lengths into a duct having a rectangular configuration." (PX-1).

13. The prosecution history of the '903 "machine" patent is quite straight-forward and provides a clear explanation of why the Patent and Trademark Office granted this patent. Specifically, in the first Official Action, all of the 33 originally filed claims were rejected over the prior art, the Patent Office placing primary reliance on the Kinkead patent No. 2,502,012 (PX-2, p. 52-54). In a responsive Amendment, applicants cancelled original Claims 1-33 and substituted new Claims 34-65 (patent Claims 1-32) (PX-2, p. 56-64).

14. In this responsive Amendment, applicants presented to the Patent Office a number of arguments to distinguish Claim 34 (patent Claim 1) from the cited references and, particularly, the Kinkead patent No. 2,502,012. For example, applicants made the following comment: "In the interview it was also pointed out that Claim 34 (patent Claim 1) recites structure which clearly is adapted to utilize a pair of spaced, flat metal sheets and to form a rectangular duct therefrom in a continuous operation without first securing the extreme lateral portions of the duct together as is done by Kinkead." (PX-2, p. 66). Applicants also stated: "Claim 34 (patent Claim 1) specifies that the two series of rotary die members are spaced from each other. *There are no rotary die members in Kinkead.*" (emphasis added) (PX-2, p. 66). Applicants further stated "Claim 34 (patent Claim 1) specifies that the duct forming mechanism includes two series of successive pairs of cooperative rotary

die members, each of which is disposed along one of a pair of spaced metal sheet paths. These paths extend longitudinally of the frame. The Claim further specifies that the pairs of rotary die members of each of said series are mounted for rotation at spaced locations along the length of the frame, and that some of them are also disposed at locations spaced transversely of the same. *None of the references contain any suggestion of such a construction.*" (emphasis added) (PX-2, p. 67). The remaining claims of the 903 patent are all dependent from and include the limitations of application Claim 34 (patent Claim 1). Accordingly, the remarks used to distinguish Claim 1 over the Kinkead patent and the other references apply also to those remaining claims (e.g., application Claim 41 which is asserted Claim 8). In the next Official Action, all of the pending claims were allowed (PX-2, p. 68).

15. The prosecution history of the '903 "machine' patent is significant as developed hereafter, in that defendants contend that the prior art on which they rely provides the identical subject matter that: (1) applicants argued was *absent* from the Kinkead patent, and (2) is defined in the claims allowed by the Patent Office.

The '088 "Method" Patent In Suit

16. The '088 "method" patent is entitled "Method of Forming A Rectangular Heat Duct" and was issued on July 30, 1974, based on an application filed June 6, 1973[1] (PX-3). It is assigned on its face to MSI (PX-3) The specification of the '088 "method" patent is substan-

[1]The 088 patent is a re-issue of the original patent No. 3,722,443 (PX-5), which issued on March 27, 1973, based on an application filed on December 8, 1971, which was a division of the application which matured into the '903 "machine" patent in suit (PX-2).

tially identical to the specification of the '903 "machine" patent (PX-1&3). Parenthetically, the specification fails to state that a new method was "invented", although the specification appears to include a description of how the disclosed machine operates (PX-1&3).

17. More specifically, the '088 "method" patent describes and illustrates a machine for continuously shaping and forming two sheets of metal into a rectangular-shaped duct. The machine accommodates two flat metal sheets and subjects each of the metal sheets to the following deforming steps: At Station No. 1 (Fig. 3), longitudinal and lateral strengthening ribs are formed into the sheets; at Station No. 2 (Fig. 4), the outer lateral portions start to be formed into seam portions at Station No. 3 (Fig. 5), the outer lateral portions are further formed and the inner lateral portions start to be formed (to form the duct corners); at Station No. 4 (Fig. 6), the inner lateral portions are further formed; at Station No. 5 (Fig. 7), the inner lateral portions are further formed; at Station No. 6 (Fig. 8), the inner lateral portions are further formed almost perpendicular to the metal sheets; at Station No. 7 (Fig. 9), the inner lateral portions are formed perpendicular to the sheets and the outer lateral portions are brought together; at Station No. 8 (Fig. 10), the outer lateral portions are joined together; and at Station No. 9 (Fig. 11), the outer lateral portions are crimped or staked together (PX-3).

18. The '088 "method" patent was issued with 34 claims, 6 independent claims, and 28 more narrow dependent claims (PX-3). Each of these claims is directed to a method of forming a rectangular duct in a single contin-

uous operation (PX-3). Of the 34 claims in the '088 patent, only claim 22, one of the narrowest claims, is asserted by MSI (PX-3). Because Claim 22 is dependent from Claim 1, it includes all of the method steps recited in both Claims 1 and 22, as set forth below:

"1. A method of forming a rectangular air duct in a single continuous operation consisting in:

a. providing a pair of elongated flat metal sheets in spaced parallel relation,

b. progressively crimping the inner lateral portions at each side of each of said sheets longitudinally from one of its ends toward the other along a corner line to facilitate bending of the lateral portions of each of such sheets toward the corresponding lateral portions of the other,

c. bending simultaneously the lateral portions of such sheets toward each other progressively in increments along their lengths until the lateral portions of one of such sheets abuts the lateral portions of the other throughout their lengths and a rectangular configuration in cross-section is thereby defined, and

d. progressively forming an interlocking seam in the abutting lateral portions of such sheets from a point adjacent one of their ends toward the other to positively lock and maintain such sheets in a cooperative rectangular duct-defining relation."

"22. The method defined in Claim wherein said bending operation includes camming the lateral portions of such sheets toward each other progressively in increments along their lengths, and

e. progressively bending the outer lateral portions of said sheets longitudinally along seam lines so as to cause said outer lateral portions to extend substantially normal to their adjacent inner lateral portions and parallel to and in abutting relation in part at least to each other when the rectangular configuration has been defined." (PX-3).

19. The prosecution history of the '088 "method" patent is rather abbreviated, but again provides a clear explanation of how the Patent Office granted this patent. Briefly the prosecution history starts with the filing of a divisional application (i.e., application based on the '903 application) which matured into the '443 patent (PX-4). Subsequent to the issuance of the '443 patent, a re-issue application was filed which matured into the '08 "method" patent (PX-6).

20. Specifically, the original application as filed included Claims 1-19 (PX-6, p. 39). All of these claims were allowed on the first Official Action without argument (PX-6, p. 54). The references cited by the Examiner against the '443 patent were the same as those cited against the '903 "machine" patent, except for the inclusion of Janecek patent No. 3,457,629 which relates to the construction of an oven wall (PX-6, p. 57). The '443 patent was amended after allowance to add Claims 20-22 which are dependent from Claim 1 (PX-6, p. 58). This Amendment was entered without comment by the Examiner (PX-6, p. 69).

21. After Claims 1-20 were allowed and prosecution on the merits closed (PX-6, p. 54), the Wogerbauer patent No. 3,545,496 (among others) was called to the attention of the Patent Office Examiner by the applicants (PX-6, p. 61). However, the Examiner did not officially cite the Wogerbauer patent (PX-3 to 6) and there is no evidence in the record that he even considered it (PX-3 to 6). Moreover, plaintiff's expert witness, Mr. Hopkins, a patent attorney, testified that he was unaware of any rule requiring the Examiner to review patents cited by an applicant to the Patent Office (TT 937-8). Moreover, the Manual of Patent Examining Procedure, §707.05 (b) provided in 1972 that: "Prior art cited by applicant's attorneys or agents *prior to final rejection or allowance* will be fully considered by the Examiner, will be part of the official record and will be included in the list of references cited . . ." (Emphasis added). Hence, because the citation of the Wogerbauer patent was made *after* all of the then pending claims were "indicated as being allowable" (and prosecution on the merits was closed), the Examiner was *not* duty bound to consider the Wogerbauer patent and there is no presumption that he did consider it.

22. The application for the '088 "method" patent was submitted with Claims 1-22 (identical to Claims 1-22 in the '443 patent) and additional Claims 23-34, which were said to be necessary to cover the embodiment shown in Figures 17-28 of the '443 patent (PX-4, p. 26). Claims 1-34 of the '088 patent were allowed on the first Official Action without argument, the Examiner citing merely the same art that was cited against the '443 patent (PX-4, pp. 48-49).

23. The prosecution history of the '088 "method" patent is significant, because both applications were allowed on the first Official Action and the art cited against both applications is essentially the same as (and no more pertinent than) the art cited against the '903 "machine" patent. This cited art, according to defendants, is not as pertinent as the prior art on which defendants now rely.

The '830 "Duct" Patent In Suit

24. The '830 "duct" patent is entitled "Rectangular Air Duct" and was issued on September 11, 1973 based on an application filed July 19, 1971[1] (PX-7). It is assigned on its face to MSI (PX-7). The specification of the '830 "duct" patent is substantially identical to the specification of the '903 "machine" patent (PX-1&7). Parenthetically, the specification fails to state that a new duct was "invented", although the specification appears to include a description of the type of duct made by the disclosed machine (PX-1&7).

25. More specifically, the '830 "duct" patent describes and illustrates a machine for continuously shaping and forming two sheets of metal into a rectangular-shaped duct. The rectangular cross-section of the duct is illustrated in Fig. 11 as it appears at Station No. 9. An enlargement of one of the seams, in unflattened form, is shown in Fig. 16. However, if it is desired to flatten the seam (col. 16, lines 8-28), then the duct is passed through Stations Nos. 10 and 11 (Figs. 30 and 31). Fig. 12 illustrates the formation of two metal sheets into a duct with flattened

[1]The '830 duct patent in suit was issued on September 11, 1973, based on an application filed on July 19, 1971, which was a division of the application which matured into the '903 "machine" patent.

scams as it progresses through the machine from Stations Nos. 1-11 (PX-7).

26. The '830 duct patent issued with four claims, Claim 1 being independent and Claims 2-4 being dependent (PX-7). Each of these claims is directed to a duct, per se (PX-7). Of the four claims, only Claim 4, which is probably the most detailed Claim, is asserted. Because Claim 4 is dependent from Claim 1, it includes all of the subject matter of both Claims 1 and 4 and is set forth below:

"1. A rigid non-collapsible rectangular heating, cooling, and ventilating air conduit as conventionally used in the heating, air conditioning, and ventilation fields comprising:

a. a pair of elongated metal sheet members of substantially equal length,

b. the lateral portions of at least one said members having been bent progressively inwardly at right angles toward the other of said sheet members and meeting lateral portions thereof and cooperatively defining therewith a rigid non-collapsible heating, cooling, and ventilating air duct having a rectangular interior when considered cross-sectionally,

c. the corresponding lateral portions of said sheet members cooperatively constituting a pair of longitudinally extending seams, one each of which is disposed at opposite sides of the conduit,

d. each of said seams being comprised of a sealing flange element carried by the lateral edge

portions of one of said members and a lip element carried by the corresponding lateral edge portions of the other of said sheet members,

e. said lip element extending along opposite sides and around the edge of said flange element,

g. each of the portions of said lip element disposed at opposite sides of said flange element and the portion of said flange element disposed therebetween being cooperatively deformed at spaced locations along the length of said seams to seal and interlock said elements and thereby secure said sheet members to each other in interlocking conduit-defining relation."

"4. The structure defined in Claim 1 wherein at each of said deformations, portions of said lip element extend into the plane of said flange element and portions of said flange element extend into the opposite portions of said lip element." (PX-7).

27. The prosecution history of the '830 "duct" patent is somewhat more extensive than the history of the '903 "machine" patent and the '088 "method" patent. As filed, the '830 application included Claims 1-10 (PX-8, p. 35-37). These Claims were rejected over prior art patents in the first Office Action (PX-8, p. 52-55). Thereafter, Claims 1-10 were cancelled and new Claims 11-13 added PX-8, p. 57, 58). In the second Official Action, these new Claims 11-13 were also rejected over the Hart patent No. 435,419, in view of the Belgian patent No. 503,979 and the Josephson patent No. 3,192,356 (PX-8, p. 69, 70). In a responsive Amendment, Claim 11 was cancelled and a

new Claim 14 (patent Claim 1) was substituted for application Claim 11 (PX-8, p. 71, 72). The following arguments were made by applicants to distinguish Claim 14 (patent Claim 1) over the Belgian and Josephson patents: (1) "Since relative longitudinal shifting is necessary to attain the object of the invention of the basic reference, [the Belgian patent], the application of the Josephson teaching thereto is an improper modification and unsound as a basis for rejection of the applicant's claims" (PX-8, p. 73). (2) The limitations of the new Claim 14 require that "the portions of the lip element which extend at each side of the flange element are each deformed as the flange element therebetween is deformed. The Josephson patent clearly teaches that deformations are made at only one side of the fabric as will be clearly seen with reference to Figure 17. In other words, all that the Josephson patent teaches is that the metal should be deformed at one side so as to depress portions thereof into the fabric to provide stakes, but it clearly does not teach that the metal at the opposite side of the fabric should also be deformed" (PX-8, p. 74). (3) "No interlocking between the two pieces of metal is accomplished by Josephson . . ." (PX-8, p. 74). (4) "Claim 14 (patent Claim 1) as drafted calls for a rigid noncollapsible, rectangular air conduit. . . . The Josephson structure is clearly by definition collapsible, and the Hart reference shows only a circular pipe with spiral seams" (PX-8, p. 75). (5) With respect to Application Claim 15 (patent Claim 4), applicants stated: "New Claim 15 (patent Claim 4) is also properly allowable in that it recites that portions of the lip element extend into the plane of the flange element, and portions of the flange element extend into opposite portions of the lip element. None of

the patents contain any teachings that portions of the flange element . . . should extend into the opposite portions of the lip element" (PX-8, p. 75).

28. In the next Official Action, the application Claims 12-15 were allowed (PX-8, p. 77). Thereafter, applicants submitted an Amendment to Claim 14 (patent Claim 1), by which it sought to restrict the claimed subject matter to the heating, cooling, and ventilation fields (PX-8, p. 80). Applicants stated: "The amendments restrict the invention to the heating, cooling and ventilating fields in contrast to the broader form of the invention as presently covered by Claim 14 (patent Claim 1) which would cover, in effect, any conduit capable of conveying air, irrespective of its size or configuration" (PX-8, p. 82). The Examiner responded to applicants' proposed Amendment by noting that the Amendment was "entered as directed *to matters of form not affecting the scope of the invention.*" (Emphasis added) (PX-8, p. 83). It is significant that the Examiner could have acquiesced in applicants' position by responding with the notation "entered", but he did not (PX-8, p. 83).

29. The file history of the '830 "duct" patent is significant, in that defendants contend that the remarks which were used to distinguish the application claims over the cited art do *not* distinguish those claims from the prior art on which defendants now rely—and, thus, render the art on which defendants rely more pertinent than that considered by the Patent Office. It further establishes that the Patent Office, notwithstanding an attempt by applicants to limit the claims to ducts in the heating, cooling and ventilation field, considered the claims to be broadly directed

to any air conduit. Thus, any prior art on which defendants rely need not be restricted to ducts in the heating, cooling and ventilation fields to be considered "analoguous art", but may be any type of conduit adapted to conduct air (i.e., as defined in the claims before applicants' attempted restricted amendments).

Obviousness Under 35 USC §103

30. One of the primary issues in the present action is whether asserted Claim 8 of the '903 "machine" patent, asserted Claim 22 of the '088 "method" patent, and asserted 4 of the '830 "duct" patent are invalid for obviousness under 35 USC §103 which states:

> "A patent may not be obtained though the invention is not identically disclosed or described as set forth in section 102 of this title, if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made."

31. In any consideration of "obviousness" under 35 USC §103, the Court is obliged to follow the guidelines prescribed by the Supreme Court in *Graham* v. *Deere,* 383 U. S. 1, 17 (1965), as follows:

> "Under §103, the scope and content of *the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved.* Against this background, the obviousness or nonobviousness of the subject matter is determined. Such secondary considerations as commercial success, long felt but unsolved needs, failure of others, etc., *might be utilized* to give light to the circumstances surrounding the origin of the subject matter sought to be patented. As indicia of obviousness or nonobviousness, these inquiries *may* have relevancy" (Emphasis added).

Each of these inquiries is examined below.

The Scope and Content of the Prior Art

32. In support of its contention that the asserted claims of the patents in suit are invalid for obviousness under 35 USC §103, defendants rely primarily upon the Vulcan Machine (DX-A), the Wogerbauer patent No. 3,545,496 (DX-C), the Lockformer Machine (Cliprol) (DX-B), and the Tishken Product (DX-E). More specifically, in regard to asserted Claim 8 of the '903 "machine" patent, defendants rely primarily upon the Vulcan Machine (DX-A) alone (or alternatively, the Wogerbauer patent (DX-C) alone) or in combination with the Lockformer Machine (DX-B). In regard to asserted Claim 22 of the '088 "method" patent, defendants rely primarily upon the Vulcan Machine (DX-A) alone or in combination with the Tishken Product (DX-E). In regard to asserted Claim 4 of the '830 "duct" patent, defendants rely primarily upon the Vulcan Duct (DX-XEE) alone or in combination with the Tishken Product (DX-E) and/or the level of ordinary skill.

33. *The Vulcan Machine.* Defendants contend that the Vulcan Machine and its duct product are "prior art"

to the '903 "machine" patent, the '088 "method" patent, and the 830 "duct" patent. MSI contends, on the contrary, that the Vulcan Machine and its duct product are not "prior art".

34. In proving-up the Vulcan Machine, defendants rely upon the deposition of Mr. Norman Ashley (DX-XF), the exhibits identified in his deposition, (DX-XFA, XFC through XFE, and XEE), the depositions of Mr. Fred Watts, Jr. (DX-XE), and the exhibits identified in his deposition (DX-XEA through XEE). Mr. Ashley testified that he was the supervisor of the machine shop and maintenance for Vulcan Metal Products Co. in 1957 through 1962 (DX-XF, p. 3). He testified that, while at Vulcan Metal Products, he was involved with a continuous metal-forming machine which continuously formed or bent two sheets of material into a generally rectangular cross section and continuously crimped the two sheets together to maintain them in that shape (DX-XF, p. 4). Mr. Ashley specifically testified that this machine had a first set of rolls or dies for bending or forming one of the sheets of material, a second set of rolls or dies for bending or forming a second sheet of material, and thereafter, some type of means for crimping the two sheets of metal together (DX-XF, p. 5).

35. Mr. Ashley stated that Vulcan Metal Products first started thinking about this machine in about 1967 (DX-XF, p. 6), that this machine was first constructed in May or June of 1969 (DX-XF, p. 6), and that product identified as "our PE-10", was first made on this machine in June, 1969 (DX-XF, p. 7). Mr. Ashley also testified that this machine, built in June 1969, is illustrated in a group of photographs (DX-XFA, DX-XF, p. 7). He further testified that this machine, beginning in June 1969 and continuing through the balance of 1969, was fully accessible to the public, was placed in a public area in the plant, and was actually viewed by members of the public. (DX-XF, p. 18, 19).

36. Mr. Ashley fixed the date of the construction of the Vulcan Machine by recalling that the upper set of roller dies of the machine were sitting parallel to the floor when work was first started on the machine. This was the condition of the machine prior to Mr. Ashley's trip to Cincinnati in June of 1969 (DX-XF, p. 8-9, 32). When he returned from that trip, Mr. Ashley testified that the upper set of roller dies of the machine "were sitting at an angle instead of sitting parallel with the floor. And that kind of makes it stick in my mind" (DX-XF, p. 9). Mr. Ashley went to Cincinnati in June 1969 to purchase and "see about some equipment for the plastic department" (DX-XF, p. 8-9). A Bill of Lading dated June 11, 1969, (DX-XFC), a consignee's copy No. 35-04094, dated 6-11-69 (DX-XFD), and a document from the J. H. Day Company (DX-XFE), all relate to the equipment purchased during Mr. Ashley's trip to Cincinnati (DX-XF, p. 11). Mr. Ashley made no other trips to Cincinnati during the years 1967 through 1970 (DX-XF, p. 9). Mr. Ashley's testimony, as corroborated by the above documents, establish that the Vulcan Machine was built at least by June 11, 1969.

37. Mr. Fred Watts, Jr., of Vulcan Machine Products Co., generally corroborated Mr. Ashley's testimony. Mr. Fred Watts, Jr., testified in his deposition (DX-XE) that he was the shipping foreman of Vulcan Products during the years of 1967 through 1970 (DX-XE, p. 3). He

confirmed that he was involved with a continuous metal-forming machine for continuously forming or bending two sheets of metal into a generally rectangular cross section and continuously crimping the two sheets together (DX-XE, p. 4). Mr. Watts also confirmed that this particular machine had a first set of rolls for forming one of the sheets of material, a second set of rolls for forming a second sheet of material, and some type of crimping means for crimping or joining the sheets together (DX-XE, p. 4). In identifying the type and operation of this machine, Mr. Watts corroborates the testimony of Mr. Ashley. Mr. Watts additionally testified that this Vulcan Machine was at least discussed in 1968, that it was built in the middle part of 1969, and that the earliest date it made any product was in the middle part of 1969 (DX-XE, p. 4-5). Mr. Watts also testified that this Vulcan Machine, built in the middle part of 1969, was constructed generally as shown in photographs DX-XFA—and made duct products as typified by duct product DX-XEE. On these material points, Mr. Watts corroborates Mr. Ashley's testimony. Further, in 1969, the Vulcan Machine was accessible to the public, was located in a public area in the plant, and was viewed by members of the public (DX-XE, p. 8). On this point, Mr. Watts corroborates Mr. Ashley's testimony.

38. To confirm that the machine was developed in June of 1969, Mr. Watts referred to his notebook (DX-XEA), and specifically to an entry dated 9-29-69 which has the notation "2 X 2 porch enclosure (new)". Mr. Watts testified that this entry refers to the 2" X 2" enclosure run on the Vulcan Machine developed in mid-1969 (DX-XE, p. 10). He stated that the parentheses around the word "new" meant that the enclosure was being set up in this

machine in preparation for its sale (DX-XE, p. 11). Mr. Watts further testified that the notations in his notebook (DX-XEA) established that the rolls for the machine had been hardened and the product had been tested and tried for sale (DX-XE, p. 11).

39. MSI contends that defendants have failed to meet their burden of establishing that the Vulcan Machine was developed "prior" to the MSI continuous duct forming machine. MSI points out that the deposition of Ernest Self, a co-developer with Mr. Ashley of the Vulcan Machine, was not taken (TT 1105), thereby suggesting that the proof relating to the development of the Vulcan Machine is somehow deficient. However, counsel for MSI admitted in his closing argument that he actually talked to Mr. Self in July of this year (TT 1275). Counsel had every opportunity to take Mr. Self's deposition and cannot now complain. The Court finds that the absence of Mr. Self's deposition is of no consequence, particularly in view of the mutually corroborative testimony of Messrs. Ashley and Watts.

40. MSI challenges Mr. Ashley's failure to produce any drawings for the rotary die members used in the Vulcan Machine (TT 1099), or any dated drawings or sketches for the machine itself (TT 1099). This is not surprising, inasmuch as the Vulcan Machine was constructed from machines (or components of machines) that were already on hand (DX-XX, p. 8).

41. MSI additionally contests the date on which the Vulcan duct was first made on the Vulcan machine, urging that Mr. Asley had no records to show the date on which the Vulcan duct was made (TT 1099). The testimony of Mr. Watts regarding the entry dated 9-29-69 in

his notebook (DX-XEA), however, indicates that the 2 X 2 porch enclosure had been "tested and tried" by that date (DX-XE, p. 11). This is corroborated by Mr. Ashley's testimony that the product identified as DX-XEE was made on the machine first built in June, 1969, (DX-XF, p. 8).

42. MSI also contends that the duct product made on the Vulcan Machine in June of 1969 was not a production or commercial product (TT 1099). In support of this contention, MSI argues that the hardened or treated die members were first placed in the Vulcan Machine in approximately November of 1969 (TT 1100). MSI's suggestion that a commercial product must be made during a "production run" to establish a reduction to practice of the Vulcan Machine is specious. Indeed, all that is required is that the machine make product—and both Mr. Ashley and Watts testified that the first product made on the Vulcan Machine was the DX-XEE duct product and it was made in mid-1969 (DX-XF, p. 7, 8; DX-XE, p. 6). In regard to hardening or heat treating the die members in November of 1969, nothing in the testimony of Messrs. Ashley or Watts indicates that heat treating the die members is necessary to produce duct product identified as DX-XEE. In any event, November, 1969, still pre-dates the December 13, 1969, date of reduction to practice alleged for MSI's machine (TT 1111). MSI further contends that the testimony of Messrs. Ashley and Watts is in conflict, in that they allegedly describe the product which was produced by the Vulcan Machine as having different dimensions (TT 1100). However, both Mr. Watts and Mr. Ashley identified the duct product made by the Vulcan Machine in mid-1969 as being the same as the duct product DX-XEE (DX-XE, p. 6; DX-XF, p. 7-8).

43. MSI also contends that there is no evidence to show that the Vulcan Machine was in the same physical condition in mid-1969 as it is now (TT 1105). However, both Mr. Ashley and Mr. Watts identified the photographs DX-XFA as being photographs of the Vulcan Machine as generally constructed in mid-1969 (DX-XE, p. 5; DX-XF, p. 7). MSI further contends that its photographs of the Vulcan Machine (PX-33) show that there was a problem with the forming of the seam in the Vulcan duct product (TT 1115). Mr. George Hopkins, one of MSI's expert witnesses commenting on the Vulcan Machine photographs (PX-33), stated that the machine looked like a temporary set up to him, particularly pointing to a number of C-clamps which are attached to the machine (TT 854). However, on cross-examination, Mr. Hopkins admitted that when he visited the premises of the Vulcan Machine Products Co. in 1976 and viewed the machine in operation, it was an operative machine, still working on the day he saw it (TT 909). The Court finds that whether or not C-clamps (or a wooden trough) were or are used is relevant. The fact remains that Messrs. Ashley and Watts testified about the successful operation of the machine in 1969, and Mr. Hopkins himself testified as to the successful operation of the machine in 1976. In fact, there has been no probative testimony that the basic construction and operation of the machine have ever been changed.

44. MSI finally contends that the Vulcan Machine, if reduced to practice, was not reduced to practice until February 4, 1970, (about two months after MSI reduced its machine to practice on December 13, 1969). In support of this contention, MSI relies upon a Vulcan memorandum to its salesman and a price list, dated February 4, 1970,

announcing the sale of the enclosure or duct product (DC-XEE; TT 1111). As stated above, a reduction to practice does not require commercialization of either a machine or a product—and the belated commercialization of the Vulcan Machine and duct product in 1970 cannot and does not adversely affect or disturb the earlier reduction to practice of the Vulcan Machine and duct product in mid-1969.

45. In the Seventh Circuit, the standard of proof required in invalidating a patent under 35 USC §102 is one of "clear and convincing evidence", *Red Cross Mfg. Corp. v. Toro Sales Co.*, 525 F 2d 1135 (7th Cir. 1975). The very same standard is applied in this Circuit to a prior public use or sale under 35 USC §102, *Julian v. Drying Systems Co.*, 346 F 2d (7th Cir. 1965). While these cases apply the "clear and convincing" standard to 35 USC §102 invalidity defenses, no greater standard should logically apply to a "prior art" defense for establishing obviousness under 35 USC §103, as here. Accordingly, defendants' proof must be "clear and convincing" and defendants have a burden of establishing by "clear and convincing" evidence that its duct product was made "prior" to the subject matter of the three patents in suit.

46. As for the character of evidence necessary to meet the "clear and convincing" standard, it has been held in the Seventh Circuit that oral testimony alone is sufficient to carry the burden. For example, in *Julian* supra, the Court of Appeals concluded that the "clear and convincing" standard applies even "where an attempt is made to establish prior public use or sale solely by oral testimony". Similarly, in the Ninth Circuit, the rule is that: "Oral testimony, if of sufficient reliability and cogency, is as effective

as written or other demonstrative evidence to establish the invalidity of patents due to prior art", *King Gun Sight Co. v. Micro Sight Co.*, 218 F 2d 825 (9th Cir. 1955). The Court, therefore, finds under the foregoing authorities that oral testimony, sufficiently reliable and cogent (i.e., credible, corroborated, or the like) is sufficient to satisfy the "clear and convincing" standard applicable to prior art defenses.

47. In this action, Messrs. Ashley and Watts both recall that the Vulcan machine was operated in June of 1969, and this testimony is substantiated by the documentary evidence identified at their depositions. The Court is particularly persuaded by the manner in which Mr. Ashley used his Cincinnati trip on June 11, 1969, to fix the date of construction and operation of the Vulcan Machine on June 11, 1969. Moreover, the date of Mr. Ashley's trip to Cincinnati is confirmed by documentary evidence (DX-XFC to E). The Court is impressed by the impartiality of Messrs. Ashley and Watts. They are not parties to the above litigation or to the MSI v. Posey litigation, are not employed by any of these parties, have no financial or other interest in the above litigation, and will not be affected by the outcome of this action. The Court finds that they are, therefore, highly credible witnesses. In addition to the corroborating testimony of Messrs. Ashley and Watts, other documentary evidence identified in these depositions corroborate the existence of the Vulcan Machine and duct product in mid-1969 (DX-XEA to E). Further, the Court has been shown photographs (DX-XFA) and drawings of the actual Vulcan Machine (DX-AA) as it exists today and there has been no probative testimony that the basic

construction and operation of the machine have ever been changed. Hence, defendants have gone far beyond presenting "merely oral testimony" and have presented highly credible and persuasive evidence.

48. Accordingly, the Court finds that the defendants have satisfied their burden of establishing by "clear and convincing" evidence that the Vulcan Machine was built and operated as described by Messrs. Ashley and Watts at least as early as June 11, 1969, and that the duct product (DX-XEE) was made from that machine in June, 1969. Thus, the evidence shows and the Court finds that the Vulcan Machine was conceived in 1967 or 1968 while the MSI machine was conceived in about October, 1969; PX 15); the Vulcan Machine and duct product were reduced to practice in June, 1969; (DX-XE, pp. 5-6, 10-11; DX-XF, pp. 6-8); and the Vulcan Machine and duct product were "commercialized" in February or March, 1970, (while the MSI machine and duct was "commercialized" in April or May, 1970; TT 141). Accordingly, the Court finds that under any of the above standards, the Vulcan Machine is "prior" to the MSI machine—and, therefore, is "prior art" to the MSI machine.

49. With respect to the construction and operation of the Vulcan machine (DX-A), it is illustrated in two sets of photographs (DX-AB, AC) and in a movie film which depicts its operation (DX-AE), as well as an artist's rendering (DX-AA) which, according to Mr. Tucker, defendants' expert witness, accurately illustrates the Vulcan machine shown in (DX-AB, AC, and AE (TT 527). With a minor irrelevant exception, MSI had no objection to the artist's rendering (TT 441). Because DX-AA most clearly

shows the various components of the Vulcan Machine and the way in which the Vulcan Duct is progressively formed, the Vulcan Machine is described below with reference to DX-AA.

50. The Vulcan Machine has an elongated frame supporting an upper and a lower series of successive pairs of rotary die members. It is capable of continuously forming a rectangular duct from pairs of rectangular metal sheets. The upper series of die members receives a relatively narrow metal sheet which is progressively formed into a U-shape having upturned flanges at their edges. The lower series of die members receives a wider metal sheet which is progressively formed into a U-shape having lips at their edges. Thereafter, the lips of the lower metal sheet and the flanges of the upper metal sheet are joined together and staked or crimped together to form a rectangular-shaped duct (TT 515). The Vulcan Machine has two metal sheet paths, the upper path having five stations with upper and lower cooperative rotary dies at each station for cooperatively forming the upper metal sheet. The lower metal sheet path has twelve stations, the first eight of which have upper and lower cooperative rotary dies for forming the lower sheet of metal. The last four stations join the lips of the lower metal sheet with the flanges on the upper metal sheet, and crimp the lips and flanges together to fixedly secure the metal sheets together (TT 515-527).

51. At the 1st station in the upper metal sheet path (DX-AA, p. 3), there is a pair of cooperative rotary dies having laterally spaced die members that function to form the initial bends in the outer lateral edges of the sheet (TT

519). At the 2nd and 3rd stations (DX-AA, p. 4-5), there are provided pairs of cooperative rotary dies with associated die members that progressively further shape the outer lateral edges of the metal sheet (TT 520). At the 4th and 5th stations (DX-AA, p. 6-7), there are likewise provided pairs of cooperative rotary dies having associated die members that progressively bend the lateral edges to form, among other things, vertically extending flanges (which form part of an interlocking seam) (TT 520-521).

52. At the 1st station in the lower metal sheet path (DX-AA, p. 8), there is provided a pair of cooperative rotary dies including spaced die members that function to bend the outer lateral edges of the lower metal sheet slightly upwardly and outwardly (to form an interlocking seam) (TT 521). At Station 2 (DX-AA, p. 9), a second set of cooperative rotary dies including spaced die members further bend the outer lateral portions of the metal sheet (TT 522). In Station 3 (DX-AA, p. 10), another pair of cooperative rotary dies including spaced rotary die members further bends the outer lateral portions of the metal sheet (TT 522). At Station 4 (DX-AA, p. 11), another pair of cooperative rotary dies including spaced die members continue to bend the outer lateral portions of the metal sheet (TT 522). At the 5th Station (DX-AA, p. 12), another pair of cooperative rotary dies including spaced die members further deform the outer lateral edges of the metal sheet (TT 523). At Stations 6 and 7 (DX-AA, p. 13-14), additional pairs of cooperative rotary dies having spaced die members progressively form the inner lateral portions of the metal sheet (TT 523). At Station 8 (DX-AA, p. 15), there is provided a rotary die including spaced die members adapted to coact with a roller form of fixed die members; the die members function to further form the inner lateral portions of the metal sheet (TT 524). At Station 9 (DX-AA, p. 16), the idler roller urges the upper metal sheet toward engagement with the lower metal sheet (TT 525). At Station 10 (DX-AA, p. 17), there is provided lower rotary die members and a pair of side idlers or camming rolls which urge the upper and lower metal sheets together (TT 525). At Station 11 (DX-AA, p. 18), upper and lower rollers and a pair of side-camming rollers urge the flanges on the upper metal sheet to engage the lips of the lower metal sheet, so as to join the two sheets together (TT 526). At Station 12 (DX-AA, p. 19), a lower roller and upper and side staking rollers interlock the lips and flanges of the lower and upper metal sheets together and form a rectangular-shaped duct (TT 527). According to Mr. Tucker's uncontradicted testimony, the Vulcan Machine makes a fifty-foot length of duct in twenty seconds (TT 528-529).

53. *The Vulcan Duct.* The duct formed by the Vulcan Machine is typified by the duct specimen DX-XEE (DX-XE, p. 6, DX-XF, p. 7). Mr. Tucker testified that the artist's sketch (DX-AD) is an accurate illustration of the Vulcan duct (TT 546). Defendants' Exhibit AD was admitted without objection. The Vulcan duct (DX-AD) is a rigid, non-collapsible conduit having a pair of elongated metal sheets of substantially equal length (TT 547). The metal sheets have inner-lateral portions which are bent inwardly at right angles towards one another to form a rigid duct with a generally rectangular interior (TT 548). The generally rectangular nature of the interior of the Vulcan duct is apparent from DX-XEE and AD. The Vulcan

duct also has corresponding outer lateral portions which form a pair of interlocking seams extending longitudinally on opposite sides of the duct (TT 548). Each seam comprises a flange element from the upper sheet and a lip element from the lower sheet, the lip element extending along opposite sides and around the flange element (TT 548). To secure the metal sheets together, the lip and flange elements are cooperatively deformed (crimped) (TT 549).

54. *The Wogerbauer Patent No. 3,545,496* (DX-C). It discloses a machine similar to the Vulcan Machine, capable of continuously forming a duct from a pair of metal sheets. Like the Vulcan Machine, it includes a frame having two series of pairs of cooperative rotary die members for continuously forming a tube or duct from two metal sheets. The sheets progress along two parallel paths and are simultaneously formed by the two series of pairs of cooperative rotary die members into a tube or duct whose interior is generally rectangular (TT 565, 69) (DX-C, Fig. 25a). The Wogerbauer Machine differs from the Vulcan Machine in that the upper and lower metal sheets are welded together, instead of crimped together as is in the Vulcan Machine (TT 569).

55. As best shown in Fig. 25 of the Wogerbauer patent, there is clearly shown two parallel paths along which two metal sheets move. Three pairs of cooperative roller dies having spaced die members, identified by the numerals 31, 32 and 33, are located along the upper path to successively bend the upper metal sheet into a downwardly open U-shaped channel member (TT 566-68). Three pairs of cooperative roller dies having spaced die members, identified as 310, 320, and 330, are located along

the lower path to successively bend the lower metal sheet into an upwardly open U-shaped channel member (TT 568-69). More specifically, the roller dies 31, 32 and 33 progressively shape the upper metal sheet into the shapes shown in Fig. 25a (TT 566-68). The rollers 310, 320, and 330 progressively shape the lower metal sheet into the forms shown in Fig. 25b (TT 568-59). After the upper and lower metal sheets have been formed into facing, U-shaped channels as shown in Fig. 25b, they are moved along their respective paths into abutting relationship adjacent rollers 34 and 35, at which point they are welded together (TT 569). The cross section of the resultant duct is as shown to the right of Fig. 25b (TT 569), and is illustrated as having a generally rectangular interior (TT 569).

56. *The Lockformer Machine (Cliprol) (DX-B).* This machine was established through the deposition of Mr. Leo Gale and the exhibits identified during his deposition. MSI apparently does not challenge the "prior art" status of the Lockformer Machine, as it does the Vulcan Machine.

57. Generally, the Lockformer machine continuously forms a metal sheet into a U-shaped channel by the use of a "fixed die member" and cooperative "camming members". This machine is illustrated in photographs (DX-BB) and a Lockformer brochure (DX-BC). The Lockformer Machine is depicted in an artist's sketch (DX-BA), which clearly shows the various components of the machine and the way in which the product is made. According to Mr. Tucker, the artist's sketch (DX-BA) is an accurate representation of the Lockformer Machine and was admitted into evidence without objection (TT 443). The machine has a plurality of roller dies, camming bars, and a fixed die

member, which cooperate to form the metal sheet into a channel configuration (DX-BA, p. 1-3).

58. At the 1st station of the Lockformer Machine (DX-BA, p. 4), a metal sheet is formed by a pair of rotary die members. Immediately adjacent the 1st station, the metal sheet engages a pair of converging camming bars, which initiate the bending of the metal sheet about the fixed die member (TT 560-61). The fixed die member comprises a pair of vertically oriented, horizontally spaced, parallel plates—almost the identical form of fix die member used by MSI (TT 558). At the 2nd and 3rd stations (DX-BA, p. 5, 6), the camming bars further bend the metal sheet around the fixed die member (TT 561). At the 4th station (DX-BX, p. 7), there is no fixed die member, but a pair of rotary dies in cooperation with the camming bars form the metal sheet into a channel configuration (TT 562). At the 5th Station (DX-BA, p. 8), an upper and lower rotary die and a pair of non-powered camming members further bend the metal into a 90° channel configuration with a return lip, as shown (TT 562). At the 6th and final station (DX-BA, p. 9), a pair of rotary die members form the metal into a 90° U-shaped channel configuration (TT 562-63). Thus, the lateral portions of the metal sheet are progressively bent along a metal sheet path by a pair of bars cooperating with a fixed die member (TT 558).

59. *The Tishken Product (DX-E)* This product was established by the deposition of Mr. Marvin Engelsman and the exhibits identified in his deposition (DX-XE and DX-XGA to D). The Tishken product includes two metal sheets whose inner portions are bent into a desired configuration and whose outer-lateral portions

are joined together to form sidewardly extending seams which are crimped or staked at spaced locations along alternate sides of the seams (DX-XGD). This construction is readily observed from an inspection of a specimen of the Tishken product, DX-GC (TT 581).

60. More specifically, the Tishken product has predetermined configured body portions (not flat), inner-lateral portions, and outer-lateral portions that extend substantially normal (not normal) to the inner-lateral portions (TT 583-84). Each seam of the Tishken product includes a flange portion extending from an outer-lateral portion of one metal sheet and a lip element formed in the outer-lateral portion of the other metal sheet (TT 584). The lip element curves around and captures the flange element between upper and lower parallel portions of the lip element. To hold the lip and flange elements in an interlocked condition, the seam is staked or crimped at spaced locations such that portions of the lower lip element extend into the plane of the flange element and (although not seen in DX-E), it is problematical whether portions of the flange element extend into portions of the upper lip element (TT 585).

61. *Non-Analogous vs. Relevant Art.* MSI urges that the relevant art to the '903 "machine" patent and the '088 "method" patent is the heat duct-making machine and method art. Defendants contend that the relevant art is the metal roll-forming and metal-bending machine and method art. In support of its position, MSI urges that the relevant art is determined by the prior activities and prior practices in which the alleged inventors were active. This seems to be an over-restrictive and unrealistic approach. In sup-

port of their position, defendants contend that its broader definition of relevant art is supported by the Patent Office classification system, which is based upon different machine technology, not different product technology. Further, the Patent Office actually cited against the machine and method patents in suit, at least four patents disclosing machines and methods for making products *other* than heat ducts. MSI also apparently contends that the Wogerbauer patent is classified in a class other than the '903 "machine" patent, and this establishes the nonanalogous character of the Wogerbauer patent. Actually, patents are classified in the United States Patent Office on the basis of what is claimed in the patent, not by what is disclosed by the patent. As stated in the United States Department of Commerce publication "Development And Use of Patent Classification Systems" at p. 4 (1966), patents are classified *by the subject matter they claim*:

> "Inasmuch as nearly every U. S. Patent contains disclosure that is claimed and also disclosure that is not claimed, the general principle is that a classification system is created and a *patent shall be assigned therein on the basis of that portion of the disclosure covered by the claims rather than on a portion of the disclosure that is not claimed.*" (Emphasis added).

It is to be expected, therefore, that the Wogerbauer patent is not classified in the same technical area as plaintiff's patent. The Wogerbauer patent *discloses* a machine but *claims* the product produced by that machine. MSI's '903 patent, in contrast, not only discloses but claims a machine. But that fact certainly does not make the unclaimed machine disclosed by Wogerbauer non-analogous to the machine claimed by MSI.

62. Moreover, MSI may be estopped from contending that the machines and patents now relied upon by defendants are non-analogous. First in distinguishing over the Kinkead patent in the prosecution of the '903 "machine" patent, applicants (MSI) never alleged that the Kinkead patent was non-analogous, even though the Kinkead machine made a tubular pipe (which MSI now attempts to differentiate from a duct). Second, after prosecution on the merits was closed in the predecessor to the '088 patent, applicants (MSI) called to the attention of the Patent Office patents disclosing machines for making products *other* than heat ducts (PX-6, p. 60) and never characterized them as "non-analogous".

63. Finally, as stated in Findings of Fact No. 28 and 29, the Patent Office permitted an amendment to the claims of the '830 "duct" patent, but held that the amendment was "entered as directed to *matters of form not affecting the scope of the invention*". (Emphasis added) (PX-8, p. 83). Thus, since the unamended claims called for an air conduit, the Court finds that any air conduit or any conduit capable of conducting air (or indeed any fluid medium) pertinent prior art. In view of the Patent Office classification system, the broad machines and methods disclosed in the patents cited by the Patent Office, and the actions of the applicants (MSI) during the prosecution of the '903 "machine" patent and the '088 "method" patent, the Court finds that the relevant art with respect to the '903 "machine" patent in suit and the '088 "method" patent in suit is the metal roll-forming and metal-bending or shaping machine and method art.

64. For the reasons advanced above, the Court finds

that the Vulcan Machine (DX-A), the Wogerbauer patent (DX-C), Lockformer machine (DX-B), the Vulcan duct (DX-AD), and the Tishken duct product (DX-E) are not "non-analogous" art, but are relevant prior art to the '903 "machine" patent, the '088 "method" patent, and/or the 830 "duct" patent.

65. *The Presumption of Validity.* The '903 "machine" patent, the '088 "method" patent, and the '830 "duct" patent are presumed to be valid under 35 USC §282. However, this presumption is dissipated, greatly weakened, or destroyed by more relevant prior art not cited by the Patent Office. *Milton Manufacturing Co. v. Fotter-Weil Corp.*, 327 F 2d 437, 439 (7th Cir. 1964); *Deep Welding, Inc. v. Sciaky Bros., Inc.*, 417 F 2d 1227, 1234 (7th Cir. 1969); *Townsend Co. v. M.S.L. Industries*, 359 F 2d 814, 815 (7th Cir. 1966); *Everest & Jennings, Inc. v. Colson Corp.*, 371 F 2d 240, 243 (7th Cir. 1967); *Crane Packing Co. v. Spitfire Tool & Machine Co., Inc.*, 276 F 2d 271, 274 (7th Cir. 1960).

66. With respect to the prior art cited by the Patent Office against the '903 "machine" patent in suit and the '088 "Method" patent in suit, the cited references were the same, except for the Janeck patent which relates to the construction of an oven wall (PX-6, p. 57). The most pertinent cited reference is the Kinkead patent No. 2,502,012. As stated above, in distinguishing over the Kinkead patent, applicants (MSI) stated: "Claim 34 (patent Claim 1) specified that the two series of rotary die members are spaced from each other. *There are no rotary die members in Kinkead.*" (Emphasis added) (PX-2, p. 66). Thus, since both the Vulcan Machine and the Wogerbauer patent

each has two series of pairs of cooperative rotary die members, the Vulcan Machine and the Wogerbauer patent are more relevant than the prior art cited by the Patent Office (TT 653-54). Even Mr. Hopkins, MSI's expert witness, admitted that the Vulcan Machine, if prior art, is more pertinent than the prior art cited by the Patent Office (TT 861-62). MSI's counsel agreed (TT 1276-77). As stated in Finding No. 21, even though the Wogerbauer patent was belatedly called to the attention of the Examiner of the '088 "method" patent after prosecution on the merits was closed, there is no presumption that the Examiner even considered it (M.P.E.P., §707.05). Moreover, the Lockformer Machine discloses the same form of fixed die member (i.e., parallel vertical plates) as embodied in MSI's patented machine and is clearly more relevant than any of the references cited by the Patent Office against the '903 "machine" patent and the '088 "method" patent (TT 411-14). Further, in distinguishing over the Josephson patent in the prosecution of the '830 "duct" patent, applicants (MSI) stated: ". . . Figure 17 . . . shows deformations at the inner side of the seam, but no deformations at the other side of the seam. Thus, no interlocking between the two pieces of metal is accomplished by Josephson . . .". Thus, the Vulcan duct, the Tishken product, and Mayroth patent with respect to the interlocking side seam construction and/or the deformed flange and lip construction are each more relevant than the Josephson patent and the other references cited by the Patent Office against the '830 "duct" patent (TT 655-56, 935). Accordingly, the presumptions of validity for each of the patents in suit are overcome by the references relied upon by defendants.

Credibility of Expert Witnesses

67. The credibility of MSI's and defendants' expert witnesses should be reviewed. On the one hand, there is Professor Hochman, MSI's expert, who is a metalurgist (TT 740). He has never designed or developed a roll-forming or metal-shaping machine of the type involved in the patents in suit (TT 786). He was employed by MSI for the purpose of this action and is less than an impartial witness. MSI's other expert, Mr. Hopkins, is a patent attorney (TT 840). He has a chemical engineering degree and was a registered chemical engineer (TT 841, 844). His technical specialty has little to do with the subject matter of the patents in suit. Mr. Hopkins was also employed by MSI for the purpose of this action and is less than an impartial witness (TT 951). On the other hand, there is defendants' expert, Mr. Tucker, who is the only expert having any practical experience with the subject matter of the patents in suit (TT 452-455). Specifically, for the past 20 years, he has designed, developed, and built roll-forming and metal-shaping machines (TT 465). Examples of Mr. Tucker's machines are illustrated in photographs marked as DX-G. Moreover, Mr. Tucker was not employed by the defendants, has received no compensation of any kind for his testmony, has no equitable interest in any one of the defendants, and has no interest in the outcome of this litigation (TT 658-59). Indeed, he is truly an impartial witness.

68. Having heard the testimony of the witnesses, the Court recognizes that the testimony of the experts are in conflict in certain respects; for example, as to what is disclosed by the prior art relied upon by defendants, as to

whether the prior art on which defendants rely is non-analogous art, and as to the alleged differences between the asserted claims of the patents in suit and the prior art upon which defendants rely. Having considered the qualifications of the witnesses and having observed their conduct, particularly on cross-examination, the Court finds that the testimony of defendants' expert witness, Mr. Tucker, is more credible than either of MSI's experts, Dr. Hochman and Mr. Hopkins. Accordingly, where the testimony of Mr. Tucker, defendants' expert witness, is in conflict with the testimony of either Dr. Hochman or Mr. Hopkins, MSI experts, the Court credits the testimony of Mr. Tucker and rejects or discredits the testmony of Dr. Hochman and/or Mr. Hopkins.

The Differences Between The Prior Art and Asserted Claim 3 of the '903 Machine Patent

69. Defendants contend that the Vulcan Machine discloses each element of Claim 1 of the '903 "machine" patent (TT 616). Specifically, Mr. Tucker testified how each element of Claim 1 of the '903 "machine" patent applies to corresponding structure in the Vulcan Machine (TT 610-615). Mr. Tucker prepared a Claim Chart (DX-UA) which depicts the Vulcan Machine in the left column (DX-AA, p. 1, 2) and the elements of asserted Claim 8 in the middle column (PX-1) and indicated by red lines how the Vulcan Machine and the claim language correspond (TT 607-15). Mr. Tucker also testified how each element of dependent Claim 8 generally applies to corresponding structure in the Vulcan Machine (TT 617-618). As for the fixed die member and camming members recited in Claim 8, Mr. Tucker testified that, to the extent

that the rotary die members of the Posey machine (DX-V) (accused of being an infringement of asserted Claim 8 by MSI) act as a fixed die member and perform a camming function, that same die member and same camming function is present in the Vulcan Machine (TT 618). In fact, MSI's witness, Mr. Hopkins, admitted that the Vulcan Machine includes a fixed die member, at least in the sense that an idler roller is a rotatable form of a fixed die member (TT 916-917). He further admitted that the Vulcan Machine includes rotary members which perform a camming function (TT 911-913, 917-919), in the same sense that a roller surface acts as a cam and performs a camming function.

70. Defendants further contend that the Lockformer Machine (DX-B) discloses each element of dependent Claim 8 of the '903 "machine" patent. Mr. Tucker also testified how each element of dependent Claim 8 applies generally to corresponding structure in the Lockformer Machine (TT 615-616). This correspondence between the Lockformer Machine and dependent Claim 8 is also illustrated in Claim Chart (DX-UA), which depicts the Lockformer Machine in the right column (DX-BA, p. 1, 2). Red lines are also used to indicate how the Lockformer Machine and the claim language correspond.

71. Defendants alternatively rely upon the Wogerbauer patent as disclosing every element of Claim 1. Mr. Tucker testified how each element of Claim 1 specifically applies to corresponding structure to the Wogerbauer patent (TT 569-572). In support of their contention, defendants rely upon the deposition testimony of Mr. Anderson relating to the Wogerbauer patent (DX-XA, p. 712-17). Defendants prepared a comparative analysis, perhaps an argumentative analysis, of Mr. Anderson's testimony comparing the elements of Claim 1 of the '903 "machine" patent with the Wogerbauer patent (DX-UD).

72. MSI challenges the readability of asserted Claim 8 on the Vulcan Machine and, by the testimony of Mr. Hopkins, points to a number of alleged distinctions between the Vulcan Machine and asserted Claim 8. For example, Mr. Hopkins states that the Vulcan Machine does not produce heat duct of conventional heat duct cross-sectional dimensions (TT 977). Mr. Hopkins admits, however, that Webster's New Collegiate Dictionary (DX-GGGG) does *not* define the word "duct" in terms of its ability to carry air (TT 906-907). Moreover, MSI's other expert witness, Mr. Hochman, flatly admitted that the Vulcan duct conducts air (TT 786-787). The Court rejects MSI's contention, since the Vulcan Machine, according to the testimony of Mr. Tucker, is "a rectangular heat duct former *capable* of continuously forming a rectangular duct" (TT 529). Moreover, this phrase is somewhat vague and indefinite particularly because MSI did not identify the range of duct sizes that would be "of conventional heat duct cross-sectional dimensions". Further, the MSI machine was designed to make duct for mobile homes, which is presumably of a different size than the duct used for conventional home or industrial applications. Claim 8 includes no mobile home duct language. To the extent that this term is definite, the Vulcan Machine may very well produce duct of "conventional" size for heating small spaces or for conducting heated air through small passageways. Mr. Hopkins further contends that the Vulcan duct is not rectangular (TT 878). This is a specious argument, since

the Vulcan duct is generally rectangular, and certainly is rectangular as compared to triangular, circular, or polygonal.

73. Mr. Hopkins further contends that the Vulcan Machine utilizes metal strips rather than metal sheets as called for in Claim 1 (TT 878). This contention is without merit. The Vulcan Machine certainly uses metal sheets which are rolled and formed in substantially the same manner as the sheets in the MSI machine. Mr. Hochman also alludes to the difference in thickness between the metal used in the Vulcan Machine and in the MSI machine (TT 781). This difference in metal thickness is of no consequence, simply because the claims do not define any thickness range for the metal sheets.

74. Mr. Hopkins additionally asserts that the die members of the Vulcan Machine are not spaced transversely of the frame (TT 883). On the contrary, as shown in DX-AA, the metal shaping portions of the Vulcan rotary dies are spaced transversely, as they necessarily must be, to bend the lateral portions or edges of the sheet metal. Indeed, in both the Vulcan Machine and the MSI patented machine, rotary dies with spaced rotary die members are employed. In the MSI machine, the rotary die members are spaced apart by small diameter members, while on the Vulcan machine, the rotary die members are located at the ends of integral members and, thus, are similarly spaced apart. Importantly, in the MSI and the Vulcan Machine, the rotary die members are doing the same thing—forming the outer-lateral portions into a interlocking seam.

75. Mr. Hopkins further states that the rotary die members of the Vulcan Machine are not spaced to engage the

lateral portions of the sheets so as to form the sheets in a "free-flowing" condition as the MSI machine does (TT 883). Mr. Hochman also referred to this free-flowing concept embodied in the MSI machine (TT 755). However, Mr. Hochman admitted that the structure shown in Figure 6 of the '903 "machine" patent does not illustrate this "free-flowing" concept (TT 755). More importantly, Mr. Hochman testified that neither Claim 1 of the '903 "machine" patent nor any other of the asserted claims made reference to the "free-flowing" concept (TT 799-804). Nothing is more fundamental in the patent law than the time-honored concept that "the claims of a patent are the sole measure of the patent grant." *Aro Mfg. Co. v. Convertible Top Co.*, 365 U.S. 336, 339 (1961). Thus, a patented invention is not defined, as MSI suggests, by the commercial structures manufactured by the patent owner, an accused infringer, or some third party. *Universal Oil Prod. Co. v. Globe Oil & Refining Co.*, 137 F. 2d 3, 6 (7th Cir. 1943; *Peters & Russell, Inc. v. Dorfman*, 188 F. 2d 711, 714 (7th Cir. 1951). Instead, the scope of the proprietary right obtained by a patentee can *only* be measured by reference to the *claims* of his patent. MSI further contends, assuming the Vulcan Machine has a fixed die member and a plurality of camming members, that the camming members do not cooperatively shape the lateral portions of both sheets. Under MSI interpretation of Claim 8, the "tophat" embodiment in Figures 17-28 in the '903 patent would *not* be covered by Claim 8 (which MSI contends embodies its allegedly unique "free-flowing" concept).

76. MSI contends that the Wogerbauer patent is a process patent and includes only a sketchy disclosure of a machine (TT 1124) which makes tubes (not duct) that are

not used to conduct air (TT 1124). This argument is sketchy, since the Wogerbauer patent adequately and clearly discloses the two series of pairs of cooperative rotary die members (DX-C). Indeed, defendants' expert, Mr. Tucker, had no difficulty in understanding what is disclosed by the Wogerbauer patent (TT 565). Moreover, Mr. Anderson testified in his deposition that the Wogerbauer tubes were capable of conducting air (DX-XA, p. 717).

77. Mr. Hopkins also contends that the Lockformer Machine does not have a "fixed die member" (TT 888). This contention strains, if not ruptures, Mr. Hopkins' credibility. The Lockformer Machine clearly embodies a "fixed die member" and a "plurality of camming members" for cooperating with the "fixed die member". Indeed, the "fixed die member" in the Lockformer Machine comprises a pair of vertical plates (DX-BA, p. 3) of almost exactly the same construction as that embodiment in MSI's machine (PX-6, 21B, 21C, 21D).

78. Having considered the exhibits of the parties, the deposition testimony and associated exhibits, and the testimony of the witnesses in attendance at the trial, the Court finds that the Vulcan Machine (DX-A) discloses the subject matter defined by Claim 1 of the '903 "machine" patent. Similarly, the Court finds that the Wogerbauer patent (DX-C) also discloses the subject matter of Claim 1 of the '903 "machine" patent, which in many respects (if not all) has been admitted by Mr. Anderson (D-XA, p. 711-17; DX-UD). Although the constructional details of the Vulcan and Wogerbauer Machines may differ, these differences are not significant in view of the broad scope of Claim 1. The Court further finds that the Vulcan Machine discloses generally the subject matter of dependent Claim 8 of the '903 "machine" patent. This Finding is made independently of MSI's charge of infringement against the Posey Machine (DX-V), which equates a rotary member to a fixed die member and rotary die members to a plurality of camming members. In addition, the Court finds that the Lockformer Machine (DX-B) discloses the subject matter defined by dependent Claim 8.

79. More specifically, the Court finds that the Vulcan Machine and the Wogerbauer Machine each disclose a rectangular duct former as set forth in the preamble of Claim 1 of the '903 "machine" patent. Each also discloses "an elongated frame", "two series of successive pairs of cooperative rotary die members", and "progressive means" for moving the metal sheets through the machine, as defined by Claim 1. The Vulcan Machine also discloses a "fixed die member" and a plurality of camming members", as defined by dependent Claim 8 of the '903 "machine" patent. The Lockformer Machine specifically discloses a "fixed die member", and a "plurality of camming members" adapted to cooperate with the fixed die member, as defined by dependent Claim 8.

80. Having considered the exhibits of the parties, the deposition testimony and associated exhibits, and the testimony of the witnesses in attendance at the trial, the Court finds that: (a) there are no real differences between the Vulcan Machine and asserted Claim 8 of the '903 "machine" patent, (b) there are no differences between the combination of the Vulcan Machine and the Lockformer Machine and asserted Claim 8, and (c) there are no differences between the combination of the Wogerbauer patent and the Lockformer Machine and asserted Claim 8.

The Differences Between the Prior Art and Asserted Claim 22 of the '088 "Method" patent

81. Defendants contend that the Vulcan method discloses each step of Claim 1 of the '088 "method" patent. Mr. Tucker testified how each step of Claim 1 of the '088 "method" patent applies to corresponding steps performed by the Vulcan Machine (TT 626-630). Mr. Tucker prepared a Claim Chart (DX-UB) which depicts the Vulcan (machine) method in the left column and the steps of asserted Claim 22 in the right column—and indicated by red lines how the Vulcan method and the claim language correspond (TT 626-627). Mr. Tucker further testified that the camming step recited in the preamble of dependent Claim 22 was also performed by the Vulcan method. Mr. Tucker testified that the cooperative roller die members of the Vulcan machine perform that camming step, in the same sense as the roller die members of the Posey machine (accused of being an infringement of asserted Claim 22 by MSI) perform the same camming step (TT 633).

82. Defendants further contend that the Tishken product (DX-E) discloses the seam construction (and the method of forming its seam) set forth in step (e) of dependent Claim 22 of the '088 "method" patent. Mr. Tucker also testified how the step of dependent Claim 22 applies generally to the Tishken product (and the method of forming its seam) (TT 626-27). Mr. Tucker further testified that the Tishken seams were staked by two gears, one on top of the other, according to the normal staking process (TT 691). In further support of their contention, defendants rely on the deposition testimony of Mr. Englesman, an employee of Tishken Products (DX-XG, p. 5). Mr. Englesman testified as to how a lockseam was formed with the use of a staking roll and a top flat roll (DX-XG, p. 13) and illustrated the method in a hand sketch (DX-XGA).

83. MSI challenges the readability of asserted Claim 22 on the Vulcan method. For example, with specific reference to the preamble of Claim 1, Mr. Hopkins contends that the Vulcan Machine does not produce a "rectangular air duct" (TT 892, PX-137). This is essentially the same (if not the same) contention which the Court rejected above and now rejects. Mr. Hopkins testified that step (a) of Claim 1 differs from the Vulcan method in that the Vulcan Machine uses flat metal strips rather than "flat metal sheets" (TT 892). This is essentially the same (if not the same) contention which the Court rejected above and now rejects. Mr. Hopkins also contends (PX-137) that the Vulcan strips are not in "spaced parallel relation". Although the Vulcan sheets are not exactly parallel, they are substantially parallel and, at least in a functional sense, satisfy the parallel claim language.

84. Mr. Hopkins does *not* contest the readiability of step (b) of Claim 1, on the Vulcan method. In referring specifically to the language of step (b), Mr. Hopkins testified that "Now presumably they (Vulcan) do that in the broad sense, except for the term sheets" (TT 893). Parenthetically, the Vulcan Machine includes the "progressively crimping" step recited in Claim 1 in the same sense as does the Posey machine (accused by MSI of being an infringement of asserted Claim 22). Mr. Hopkins, however, does contend that step (c) of Claim 1 (which calls for simultaneously bending of top and bottom sheets) differs from the Vulcan Machine which does *not* simultaneously bend

the top and bottom sheets, but first bends the top sheet and then bends the bottom sheet (TT 894). This is a somewhat strained argument, because during the operation of the Vulcan Machine the sheets are being "continuously" and "simultanously" bent (DX-AA, DX-AE). The fact that the series of rotary dies which bend the top sheet is placed nearer to the input of the Vulcan Machine than the lower series of rotary dies is insignificant. The important point is that the sheets are being simultaneously bent so that the sheets can be joined together "continuously" to form the rectangular duct.

85. With respect to step (d) of Claim 1, MSI contends that the Vulcan method does not produce a duct with an "interlocking seam". Mr. Hochman testified that he was able to manually move the lip portion of MSI's version of the Vulcan duct (PX-127) relative to the flange portion and, thus, the Vulcan duct did not have an interlocking seam (TT 766). Mr. Hopkins, in referring to the Vulcan duct (PX-12), testified that the Vulcan method did not produce a duct with an interlocking seam (TT. 895). However, Mr. Hochman admitted on cross-examination that the specimen of the Vulcan duct (PX-127), about which he testified on direct examination, had been deformed (or damaged) at the end of the upper sheet and that such deformation would tend to weaken the seams of the duct (TT 789)—and, importantly, that his testimony had been based on the deformed (or damaged) Vulcan duct (PX-127). On the other hand, the Vulcan duct (DX-XEE) was marked as an exhibit (DDX-94) at the deposition of Messrs. Ashley and Watts, both of whom identified it as the product made by the Vulcan Machine in 1969 (DX-XF, p. 7; DX-XE,

p. 6). When Mr. Hochman examined this Vulcan duct (DX-XEE), he testified that the seams were tight, did not move relative to one another, and were air tight (TT 787-788). In attempting to disassemble the Vulcan duct (DX-XEE), Mr. Hochman admitted that the prospects of his doing that were "remote" (TT 794). Mr. Hopkins also examined the Vulcan duct (DX-XEE) and testified that the two sheets did not slide or move relative to one another (TT 928). When further questioned, Mr. Hopkins admitted that he did not know whether the Vulcan duct (DX-XEE) was made by a method that produced an interlocking seam (TT 948). Considering the testimony of Mr. Tucker, Mr. Hopkins, and Mr. Hochman, and the unexplained deformation of the Vulcan duct (PX-127), the Court accepted the undamaged Vulcan duct (DX-XEE) as being representative of the Vulcan duct made in 1969 and rejects the damaged Vulcan duct (PX-127). Moreover, the Court finds that the Vulcan method does produce a duct having an interlocking seam to positively lock the sheets together, as defined by step (d) of Claim 1 of the '088 "method" patent.

86. MSI initially contended, by its expert witness, Mr. Hopkins, that the Vulcan method does not perform any "camming", as recited in the preamble of dependent Claim 22 (TT 896). Specifically, Mr. Hopkins testified that "there's no camming in Vulcan at all" (TT 896). However, on cross-examination, Mr. Hopkins flatly admitted that the Vulcan method performed a camming function (TT 911-13; TT 859). In referring to the Vulcan drawings (DX-AA, p. 15) Mr. Hopkins stated the structure shown on page 15 "illustrates camming" (TT 913). More

particularly, Mr. Hopkins stated there were "some diverting conical end portions that I considered to be performing a camming action" (TT 919). Parenthetically, defendants also rely on Mr. Tucker who testified that, in the sense that the rotary dies of the Posey machine (accused by MSI of being an infringement of asserted Claim 22) performs the function of camming the lateral portions of the sheets towards each other, the rotary dies of the Vulcan Machine perform the same camming step (TT 545-546).

87. As to step (e) of dependent Claim 22, MSI contends, as Mr. Hopkins testified (and apparently as defendants agree), that the Vulcan method does *not* produce a duct having the outer-lateral portions extending substantially normal to their adjacent inner portions as required by step (e) of dependent Claim 22 (TT 897). However, the Tishken product (DX-E; DX-XGD) does have outer-lateral portions formed so as to extend "substantially normal", although not precisely normal, to their adjacent inner-lateral portions, as required by dependent Claim 22. Indeed, the angularity between the outer-lateral and inner-lateral portions, although not 90° or normal, is within the range of "substantially normal", particularly in view of MSI's failure to define an angular range for "substantially normal".

88. Having considered the exhibits of the parties, the deposition testimony and associated exhibits, and the testimony of the witnesses in attendance at the trial, the Court finds that the Vulcan Machine or method discloses the subject matter defined by Claim 1 of the '088 "method" patent and the subject matter defined by dependent Claim 22 of the '088 "method" patent, except for the lateral

orientation of the interlocking seams. The Court further finds that the Tishken product (and the method by which it is made) discloses the same laterally extending seam construction defined by dependent Claim 22.

89. More specifically, the Court finds that the Vulcan method is a method "of forming a rectangular air duct in a single continuous operation", as set forth in the preable of Claim 1 of the '088 "method" patent. The Vulcan method includes the step of "providing a pair of elongated flat metal sheets . . .", "progressively crimping the inner-lateral portions . . . to facilitate bending . . ." (particularly in the sense that the Posey method (accused by MSI of being an infringement of Claim 22) likewise includes "progressively crimping"), "bending simultaneously the lateral portions of such sheets . . .", "progressively forming an interlocking seam . . ., as called for by Claim 1. The Vulcan method also discloses "camming the lateral portions . . ." as part of the bending operation (particularly in the sense that the Posey method (accused by MSI of being an infringement of Claim 22) likewise includes "camming the lateral portions"), as set forth in the preamble of dependent Claim 22. The Tishken product (and the method by which it is made) discloses the step of "progressively bending the outer-lateral portions . . . so as to cause said outer-lateral portions to extend substantially normal . . .", as called for in step (e) of dependent Claim 22.

90. Having considered the exhibits of the parties, the deposition testimony and associated exhibits, and the testimony of the witnesses in attendance at the trial, the Court finds that: (a) there are no real differences between the Vulcan method of asserted Claim 22 of the '088 "method"

patent, and (b) there are no differences between the Vulcan method, in the context of the Tishken product (and the method by which it is made), and asserted Claim 22.

The Differences Between the Prior Art and Asserted Claim 4 of the '830 "duct" Patent

91. Defendants contend that the Vulcan duct (DX-XEE) discloses each element of Claim 1 of the '830 "duct" patent (TT 646). Mr. Tucker testified how each element of Claim 1 of the '830 "duct" patent applies to corresponding structure in the Vulcan duct (TT 642-645). Mr. Tucker prepared a Claim Chart (DX-UC) which depicts the Vulcan duct in the left column and the elements of asserted Claim 8 in the middle column (TT 641). Mr. Tucker indicated by red lines how the Vulcan duct and the claim language correspond (TT 641). Mr. Tucker also testified how each element of Claim 1 of the '830 "duct" patent applies to corresponding elements in the Belgian duct (TT 642-645).

92. Defendants also contend that the Vulcan duct generally corresponds to the language of dependent Claim 4 of the '830 "duct" patent. Mr. Tucker so testified (TT 646) and indicated by the use of red lines on the Claim Chart (DX-UC) how the Vulcan duct and the claim language generally correspond. Defendants further contend that the Tishken product discloses the subject matter of dependent Claim 4. Mr. Tucker indicated the correspondence between the language of Claim 4 and the Tishken product depicted in the right column in the Claim Chart (DX-UC) by the use of red lines.

93. MSI challenges the readability of asserted Claim 4

on the Vulcan duct and/or the Tishken product (TT 904). For example, Mr. Hopkins states that the Vulcan duct is not a rectangular heating, cooling, and ventilating air conduit as conventionally used in the heating, air conditioning and ventilation fields (TT 901). The addition of this language to this claim, as discussed above, does *not* restrict or limit the claim to this alleged field of use, because the Patent Office permitted this amendment on the specific condition that "the scope of the invention" would not be altered (PX-8, p. 83). Thus, as concluded above, the Vulcan duct does conduct air and is "a rigid non-collapsible air conduit" as originally defined in Claim 1. Moreover, the language "as conventionally used in the heating, air conditioning and ventilation fields" is vague and indefinite, particularly in light of MSI's failure to prescribe the dimensional range of the claimed type of duct. Mr. Hopkins also contends that the Vulcan duct is not rectangular and does not have a rectangular interior (TT 901). This is the same argument which the Court rejected above and now rejects again. In short, the Vulcan duct is fully responsive to the preamble of Claim 1, particularly in view of the prosecution history of this claim (PX-8, p. 83).

94. MSI does *not* dispute that the Vulcan duct has "a pair of elongated metal sheet members . . .", as defined by element (a) of Claim 1 or "lateral portions . . . being bent progressively . . .", as defined by element (b) of Claim 1 (with the exception of the "heating, cooling and ventilating air duct" and "rectangular interior" language). These points were considered in the context of the above discussion of the preamble to Claim 1 of the '830 "duct" patent and rejected then and are rejected now. MSI, however, further contends, by Mr. Hopkins, that the Vulcan duct

does not have seams disposed at opposite sides of the conduit (TT 902), as recited in paragraph (c) of Claim 1. On cross-examination, however, Mr. Hopkins admitted that a side elevational view of the Vulcan duct would show the seams (TT 932). In any event, regardless of Mr. Hopkins' testimony (which strained his credibility), the Vulcan duct (DX-XEE) does have seams disposed at its opposite sides. The fact that the seams are disposed at the upper and of the side of the Vulcan duct and that the MSI duct has seams nearer its middle is immaterial.

95. MSI does *not* dispute that the Vulcan duct has "a sealing flange element . . . and a lip element", as defined by element (d) of Claim 1 or a "lip element extending along opposite sides and around the edge of the flange element", as defined by element (e) of Claim 1. However, MSI does contend, by Mr. Hopkins, that the Vulcan duct is not cooperatively deformed at spaced locations along the length of the seams to seal and interlock the lip and flange elements, as recited in paragraph (g) of Claim 1 (TT 902-902). Mr. Hopkins stated that "the duct I examined that was in evidence did not show that interlocking" (TT 903). Mr. Hopkins admitted, however, that the seams of the Vulcan duct had "stakes and serrations" (TT 903). This is essentially the same argument made above; the Court rejected it earlier and rejects it now. The Vulcan duct (DX-XEE) does have the defined lip and flange elements cooperatively deformed at spaced locations along their lengths to provide interlocking seams, particularly in view of Mr. Hochman's testimony that the Vulcan seams were airtight and immovable (TT 782-788).

96. MSI contends that neither the Vulcan duct nor the

Tishken product have portions of an upper lip element extending into the plane of the intermediate flange element, and portions of the flange element extending into opposite portions of the lip element, as called for by dependent Claim 4 (TT 902-904). In support of MSI's position, Mr. Hochman testified that his conclusion was based on his examination of the Vulcan duct (PX-127) which the Court has earlier concluded is not representative of the Vulcan duct. Moreover, Mr. Hochman admitted that he had not previously measured the indentations on the seams of the Vulcan duct (DX-XEE) (TT 788, 791). As for the Tishen product (DX-E; DX-XGD), Mr. Hochman testified that the Vulcan duct (PX-129) had indentations in the top of the lip, but he had no knowledge as to whether those indentations extended into the flange between the upper and lower lips (TT 829). In reviewing Mr. Tucker's testimony on this point, he testified that at the deformations in the Vulcan duct the lip element extended into the flange element, but "it really hasn't been perforated deep enough to go into the receiver part of the lip" (TT 646). On cross-examination, Mr. Tucker testified that he had opened up DX-XEE type of Vulcan duct and had observed "deformations on the flange element" (TT 694). In regard to the Tishken product, Mr. Tucker testified that opposite portions of the lip element at alternate deformations extended into the flange element (TT 646-47). Mr. Tucker's testimony on cross-examination appears to be a restatement of his testimony on direct examination (TT 693-94). Thus, it is unclear whether, at the points of deformation in the Vulcan duct and Tishken's product, the flange elements "extend into the opposite portions of said lip element" (the last part of asserted Claim 4).

97. Having considered the exhibits of the parties, the deposition testimony and associated exhibits, and the testimony of the witnesses in attendance at the trial, the Court finds that the Vulcan duct (DX-AD; DX-XEE) discloses the subject matter defined by Claim 1 of the '830 "duct" patent. The Court further finds that the Vulcan duct and the Tishen product (DX-E, DX-XGD) disclose substantially all of the subject matter of dependent Claim 4.

98. More specifically, the Court finds that the Vulcan duct discloses an air conduit as defined in the preamble of Claim 1, in the context of the prosecution of Claim 1. Moreover, the Court finds that the Vulcan duct discloses a "pair of elongated metal sheet members . . .", "lateral portions . . . having been bent progressively . . . cooperatively defining a rigid non-collapsible . . . air duct having a rectangular interior . . .", "lateral portions . . . constituting a pair of longitudinally extending seams . . . at opposite sides of the conduit", "and of the seams [having] . . . a flange element . . . and a lip element", "said lip element extending along opposite sides and around the edge of said flange element", the "lip element . . . [and] flange element . . . being cooperatively deformed . . . to seal and interlock said elements . . . in interlocking conduit defining relation", as defined by Claim 1. Further, the Court finds that the Vulcan duct and the Tishken product generally disclose an interlocking seam in which the "portions of said lip element" extend into the plane of said flange element as defined by dependent Claim 4. Whether the "portions of said flange element extend into the opposite portions of said lip element", as called for in dependent Claim 4 is problematical.

99. Having considered the exhibits of the parties, the

deposition testimony and associated exhibits, and the testimony of the witnesses in attendance at the trial, the Court finds that: (a) there are no real differences between the Vulcan duct and asserted Claim 4 of the '830 "duct" patent and (b) there are no significant differences between the combination of the Vulcan duct and the Tishken product and asserted Claim 4.

The Level of Ordinary Skill

100. The Court finds that it was known to a person having ordinary skill in the roll-forming and metal-bending machine and method art and/or duct and air-conduit art, in June, 1969, or earlier to use a series of cooperative pairs of rotary die members to bend or shape metal into predetermined shapes in a continuous operation (TT 621); to design a cooperative pair of rotary die members that will produce a channel section from a flat metallic panel with outwardly extending flanges at the top of the channel (DX-XA, p. 174-176); to progressively shape a relatively flat, metallic panel into a member having a predetermined configuration by pairs of cooperative rotary die members (DX-XA, p. 174-175); to use a cooperative rotary die member to put any kind of locking structure along the longitudinal edges of a metallic member (DX-XA, p. 176); that one could achieve a particular type of locking arrangement by designing cooperative rotary die members to produce a deformation which would give one a desired locking structure (DX-XA, p. 176); to use two metal sheets and by two series of successive cooperative rotary die members continuously bend them into a generally rectangular duct configuration (TT 623); to form two separate and distinct sheets of metal into a generally rectangular

configuration by feeding one sheet of metal through an upper series of cooperative rotary die members and the other sheet through a lower series of cooperative rotary die members (DX-XA, p. 713-16); that the generally rectangular product thus formed could be increased in size by increasing the size of the rotary dies (DX-XA, p. 719-20).

101. The Court also finds that it was known to a person having ordinary skill in the roll-forming and metal-bending machine and method art and/or duct and air-conduit art, in June, 1969, or earlier, to use a fixed die member for bending metal (TT 808); to bend a metal sheet over a fixed die member by rollers (DX-M, TT 599-600); to use the fixed die member with a plurality of camming members to bend or form sheet metal as it continuously moves through a machine (TT 621); to use cooperative camming members, whether they be side idlers or camming rails, to assist in bending metal around a fixed die member (TT 808); to use cooperative rotary die members and camming members to bend or shape metal sheets into a desired configuration (TT 621); depending on the length of the machine, its expense and available space, to use rotary die members or, alternatively, fixed die members and associated camming members to bend or shape metal sheets (TT 622); to use either a stationary fixed die member or a rotary fixed die member (DX-XB, p. 71); DX-J; DX-K).

102. The Court further finds that it was known to a person having ordinary skill in the roll-forming and metal-bending machine and method art and/or duct and air-conduit art, in June, 1969, or earlier, to construct portable machines for continuously forming channel U-shaped product for use on the job site (DX-JA); that metal which had a

higher hardness characteristic would be harder to bend than metal with a lesser hardness characteristic (TT 805); that the formation of rigid metal posed a different set of conditions for bending such metal (TT 806); that there is a possibility that light metal may jam if formed too quickly or if tied too tightly between cooperative roller dies (TT 807); that thin metal would ordinarily tear if bent around a sharp corner, and that stress concentrations would occur at the point of bending any kind of metal, whether it be thin, thick or otherwise (TT 808-809).

103. The Court also finds that it was known to a person having ordinary skill in the roll-forming and metal-bending machine and method art and/or duct and air-conduit art, in June, 1969, or earlier, to construct an elongated, rectangular duct from two metal sheets, and to join the two sheets together at opposite sides of the duct so as to extend substantially normal to the inner-lateral portions of the duct, with a lip portion extending around and parallel to an intermediate flange portion, as shown in Belgian patent No. 503,979 (DX-F, TT 643); to interlock the flange and lip portions by staking or crimping, as for example, by the Whitney-Jensen clip punch (DX-TA), or as shown in Mayrath patent No. 3,208,140 (DX-S); to provide a rolled metal sheet with a lip and flange construction (DX-S, E, TT 602) wherein the lip element extends along opposite sides and around the edge of the flange element (TT 604, DX-S); to stake the lip and flange construction at spaced intervals such that portions of an upper lip element extend into the plane of the flange element and portions of the flange element extend into the plane of a lower lip element (DX-S, Fig. 2, Col. 2, lines 50-55), and that the same deformation force causes greater deformation on lighter metal (TT 838).

104. The Court finds that it would have been within the province of one having ordinary skill in the roll-forming or metal-bending machine and method art and/or duct and air-conduit art, in June, 1969, or earlier, to combine the Lockformer type fixed die member and cooperative camming members with the series of successive pairs of cooperative rotary die members in a Vulcan machine or the Wogerbauer-type machine to produce a large capacity duct (TT 625-626); to modify roll-forming machines (and specifically, to modify the Vulcan machine) so as to increase or decrease the size of the duct produced (TT 651-652); to modify the Vulcan method to produce a duct having interlocking side seams extending outwardly from opposite sides of the duct, for example, as taught by the Tishken product (TT 638); to continuously join two metal sheets together with interlocking side seams extending from opposite sides of the duct, particularly if it were desired to minimize the length of the machine (TT 637); to join two sheets of metal to form a rectangular duct having interlocking seams and to locate those seams on opposite sides of the duct (TT 648-649); to join two sheets of metal together to form a rectangular duct by the use of lip and flange seams (TT 649-650); and to make a Vulcan type duct with interlocking side seams extending outwardly from opposite sides of the duct, as shown in the Tishken product (TT 650).

Asserted Claim 8 Of The '903 "Machine" Patent
Is Invalid For Obviousness Under 35 USC §103

105. Under 35 USC §103, "A patent may not be obtained if the differences between the subject matter sought to be patented (asserted Claim 8) and the prior art (the

Vulcan Machine or Wogerbauer patent and Lockformer machine) are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains".

106. As found by the Court, there are no "differences" (to use the language of 35 USC §103) between the prior art relied upon by defendants and asserted Claim 8 of the '903 "machine" patent. Specifically, as discussed above, there are no real differences between the Vulcan Machine (DX-A) and asserted Claim 8. The Court concludes, therefore, that any differences between the subject matter of asserted Claim 8 of the '903 "machine" patent and the Vulcan Machine are such that the subject matter as a whole would have been obvious in June, 1969, to one having ordinary skill in the roll-forming and metal-bending art, particularly in view of the level of ordinary skill discussed above.

107. Further, as discussed above, there are no "differences" between the combination of the Vulcan Machine (DX-A) and the Lockformer Machine (DX-B) and asserted Claim 8. In view of the Vulcan Machine disclosing at least the subject matter of Claim 1 and the Lockformer machine disclosing the subject matter of dependent Claim 4, in the context of the ordinary skill, the Court concludes that it would have been obvious to one having ordinary skill in the roll-forming and metal-bending machine art in June, 1969, to combine the Lockformer fixed die members and associated camming members with the series of cooperative rotary die members from the Vulcan Machine to produce the combination defined by asserted Claim 8.

The Court further concludes that any differences between the subject matter of asserted Claim 8 of the '903 "machine" patent and the combination of the Vulcan Machine and the Lockformer machine are such that the subject matter as a whole would have been obvious in June, 1969, to one having ordinary skill in the roll-forming and metal-bending art. The Court makes the same findings and reaches the same conclusions with respect to the combination of the Wogerbauer patent (DX-C) and the Lockformer machine (DX-B). MSI challenges the propriety of combining the Vulcan Machine and the Lockformer Machine. This contention is without merit, since the Vulcan Machine itself includes a rotary form of fixed die members and associated camming members. This is the suggestion needed for combining the machines and provides the "link" or "bridge" for the combination.

108. The Court concludes as a matter of law that the subject matter of asserted Claim 8 as a whole, in the context of the prior art on which defendants rely, would have been obvious in June, 1969, to a person having ordinary skill in the roll-forming and/or metal-bending machine art—and asserted Claim 8 of the '903 "machine" patent is invalid under 35 USC §103.

109. The mere aggregation of a number of old parts or elements which, in the aggregation, perform or produce no new or different function or operation that that theretofore performed or produced by them, is not patentable invention (i.e., is obvious) [*Lincoln Eng. Co. v. Stewart-Warner Corp.*, 303 U.S. 545, 549 (1938); *Anderson's-Black Rock v. Pavement Co.*, 396 U.S. 57 (1969); *Sakraida v. Ag. Pro, Inc.*, 425 U.S. 273 (1976), 189 USPQ 453;

Plax Corp. v. Elmer E. Mills Corp., 204 F 2d 302, 309 (7th Cir. 1953)]. It is axiomatic that substitution of one old element for another in a combination is not patentable (i.e., is obvious). The uniting of old elements with no change in their respective functions is likewise not patentable (i.e., is obvious), *Leach v. Badger Northland, Inc.*, 385 F 2d 193, 196 (7th Cir. 1967); *Joyce v. Kahn*, 96 F 2d 866, 878 (7th Cir. 1938). Obviousness does not require that the combination of prior art references precisely duplicate the claimed subject matter. It is sufficient that the claims' subject matter taken "as a whole" be disclosed by the prior art. [*Akron Brass Co. v. Elkhart*, 353 F 2d 704, 706 (7th Cir. 1965); *Toro Mfg. Corp. v. Jacobsen*, 357 F 2d 901, 903 (7th Cir. 1966)].

110. The Supreme Court's admonition in *Great A. & P. Tea Co. v. Supermarket Equipment Corp.*, 340 U.S. 147, 152, 153 (1950), is specifically applicable to the present case:

> "Courts should scrutinize combination patent claims with a care proportioned to the difficulty and improbability of finding invention in an assenbly of old elements. The function of a patent is to add to the sum of useful knowledge. Patents cannot be sustained, when, on the contrary, their effect is to subtract from former resources freely available to skilled artisans. A patent for a combination which only unites old elements with no change in their respective functions, such as is presented here, obviously withdraws what already is known into the field of its monopoly and diminishes the resources available to skillful men. This patentee has added nothing to the total stock of knowl-

edge, but has merely brought together segments of prior art and claims them in congregation as a monopoly."

111. More recently, since *Graham v. Deere, supra,* the Supreme Court has required closer scrutiny of patented "inventions" (whether machines, methods, or products) which constitute a collection of individually old elements or steps. If each element or step of such "inventions" performs only its known function, without "synergistic effect", that combination is unpatentable, *Anderson's-Black Rock, Inc. v. Pavement Salvage Co.,* 396 U.S. 57 (1969); *Sakraida v. Ag Pro, Inc.,* 425 U.S. 273 (1976). Our own Seventh Circuit Court of Appeals has made it clear that the Supreme Court's "synergism" test is to be applied to combination patents, stating that:

> "Section 103 cannot easily be satisifed by inventions that rearrange old elements in new combinations with each element performing the same function it performed in the prior art, even though the new combination produces a more striking result that the old ones. . . . Unless the combination is "synergistic, that is, 'result[ing] in an effect greater than the sum of the several effects taken separately' " it cannot be patented, *St. Regis Paper Co. v. Bemis,* 549 F 2d 833 (7th Cir. 1977).

The Court finds that all of the elements recited in asserted Claim 8 are old in the art, each performing its own function independently of others. Indeed, counsel for MSI admitted that he never specifically asked either one of MSI's experts about "synergism" (TT 1277-78). Neither reliance on the "free flow" method concept (*not* set forth in

the '903 patent or any of its claims) nor reliance on "the steps that they took and the machine that they put together to produce that type of duct" satisfied MSI's burden of establishing "synergism" or a "synergistic effect" (TT 1277-78). Moreover, MSI has failed to adduce evidence in this record to establish the "synergism" required by the Supreme Court and the 7th Circuit Court of Appeals. The combination of elements recited in asserted Claim 8 does *not* produce a total greater than the sum of its parts—and does *not* produce a synergistic effect or result. In the case of asserted Claim 8, two plus two still equals four! Claim 8 is invalid for this reason.

112. Having concluded that asserted Claim 8 of the '903 "machine" patent is invalid as a matter of law, based upon the primary factual inquiries prescribed by the Supreme Court, the Court need not give consideration to the secondary considerations listed by the Supreme Court. See *Graham v. Deere,* 383 U.S. 1, 26 (1965), *Research Corporation v. Nasco Industries, Inc.,* 501 F.2d 358, 362 (7th Cir. 1974), and *Scott Paper Co. v. Fort Howard Paper Company,* (7th Cir. 1970). In doubtful cases (which this is not) secondary considerations may sometimes tip the scales toward validity, but they cannot be used as a substitute for invention or to offset a conclusion of obviousness based on an analysis of the primary factual inquiries, *Graham v. Deere, supra; Research v. Nasco, supra; and Scott v. Fort Howard, supra.* However, giving full consideration to the secondary consideration, such as alleged commercial success, alleged failure of others, copying and the like, in this record, the Court concludes, notwithstanding such secondary considerations, that asserted Claim 8 is invalid as a matter of law under 35 USC §103.

113. Specifically, in regard to alleged "commercial success", the MSI machine, while eventually marketable, it did meet with initial resistance by the industry (TT 1076). Moreover, it did not replace the old ADM machine, which is still being used at the AMS of Indiana and AMS of Georgia centers (TT 853). The alleged royalty was not added to the price of aluminum, but was arbitrarily designated at 4¢/foot of aluminum and the profit or mark-up on the aluminum reduced by 4¢/foot. Moreover, there is no showing by MSI that the alleged commercial success was due exclusively to the alleged inventive features, rather than to other factors such as marketing and advertising considerations (TT 444-45). See *Shelco v. Dow Chemical Co., supra; Jungersen v. Ostby & Barton Co.*, 335 U.S. 560, 567 (1949); *T.P. Laboratories, Inc. v. Huge*, 371 F 2d 231, 236 (7th Cir. 1966); *Schreyer v. Chicago Motocoil Corp.*, 118 F 2d 852, 857 (7th Cir. 1941); *Endevco Corp. v. Chicago Dynamic Industries, Inc.*, 268 F. Supp. 640, 655 (N. D. Ill. 1967). In any event, even if MSI had established "commercial success", this secondary evidence (taken by itself or with other secondary evidence) does not overcome or offset the above conclusion of obviousness by this Court based on the above primary factors.

114. In regard to alleged "failure of others", MSI apparently relies upon its own failures in developing its machine. These failures are irrelevant, since the standard is "failure of *others*". MSI also relies upon ADM's multi-purpose machine, which was never commercialized. However, the alleged failure of the multi-purpose machine resulted from over-ambitious design objectives (i.e., multiple-sized duct, which cannot be made on MSI's machine, and both aluminum and galvanized steel, the latter of which cannot

be processed through MSI's machine) (PX-133, PX-135). Moreover, the development of the multi-purpose machine occurred after development of the MSI machine and it is problematical that such belated acts would be relevant to any obviousness inquiry, which under Section 103 must be made "at the time the invention was made". In any event, even if MSI had established "failure of others", this secondary evidence (taken by itself or with other secondary evidence) does not overcome or offset the above conclusion of obviousness by this Court based on the above primary factors.

115. In regard to "copying", defendant ADM has admitted copying the MSI machine. MSI, therefore, contends that if asserted Claim 8 is so obvious, why did defendant ADM have to copy. This argument is, however, based on a faulty premise, namely, that the defendant ADM is in the same position as the "statutory" man of ordinary skill under 35 USC 103. Indeed, the "statutory" man of ordinary skill under 35 USC 103 is *presumed* as a matter of law to have knowledge of all relevant prior art. Clearly, defendant ADM is *not* presumed to have such knowledge. Moreover, there is no evidence that defendant ADM had any *actual* knowledge of either the Vulcan Machine, the Lockformer machine, or the Wogerbauer patent when it copied the MSI machine. MSI *cannot* contend that what is *presumed* as a matter of law to be known to the "statutory" man of ordinary skill under 35 USC 103 was also *actually* known to defendant ADM. Finally, what would have been obvious to the "statutory" man of ordinary skill under 35 USC 103 (in the context of *presumed* knowledge of the Vulcan Machine, the Lockformer machine, and/or the Wogerbauer patent) will be totally different than what would

have been obvious to the "real" man, i.e., defendant ADM (in the context of his *real* knowledge of prior art, *excluding* the Vulcan Machine, the Lockformer machine, and/or the Wogerbauer patent). MSI's argument is clearly specious and without merit. In any event, assuming that copying by defendant ADM is relevant, this secondary evidence (taken by itself or with other secondary evidence) does not overcome or offset the above conclusion of obviousness based on the above primary factors.

116. The Court finds that the cumulative effect or impact of the above discussed secondary considerations, as well as other secondary considerations on which MSI relies, is not adequate to overcome or offset this Court's conclusion of obviousness based on the above discussed primary considerations or factors. Moreover, considering all of the primary and secondary considerations, de novo, the Court concludes that the subject matter of asserted Claim 8 as a whole would have been obvious in June, 1969, to a person having ordinary skill in the roll-forming or metal-bending machine art. As such, the asserted Claim 8 is invalid for obviousness under 35 USC §103.

Asserted Claim 22 of The '088 "Method" Patent
Is Invalid For Obviousness Under 35 USC §103

117. As found previously by the Court, there are no "differences" between the prior art relied upon by defendants and asserted Claim 22 of the '088 "method" patent. Specifically, as discussed above, the Vulcan method discloses all the subject matter of asserted Claim 22 except for the lateral orientation of the interlocking seams. However, in the context of the level of ordinary skill in the roll-forming and metal-bending method art, the Court concludes that it would have been obvious to one having ordinary skill in this art prior to June, 1969, to dispose the outer-lateral portions (i.e., the interlocking seam) of the Vulcan duct so as to extend sidewardly "substantially normal" to their inner-lateral portions, instead of vertically. The Court concludes, therefore, that any differences between the subject matter of asserted Claim 22 of the '088 "method" patent and the Vulcan method are such that the subject matter as a whole would have been obvious in June 1969, to one having ordinary skill in the roll-forming and metal-bending method art, particularly in view of the level of ordinary skill discussed above. Hence, the Court finds that asserted Claim 22 is invalid under 35 USC §103.

118. Further, as found by the Court, there are no "differences" between the combination of the Vulcan method and the Tishken product (and the method by which it is made) and asserted Claim 22. In view of the Vulcan method disclosing the subject matter of Claim 1 and the Tishken product (and the method by which it is made) disclosing the subject matter of dependent Claim 22, the Court concludes that it would have been obvious to one having ordinary skill in the roll-forming and metal-bending method art in June, 1969, to modify the Vulcan method to produce a duct having interlocking side seams extending outwardly from opposite sides of the duct, as shown in the Tishken product (and the method by which it is made), as defined by asserted Claim 22. The Court further concludes that any difference between the subject matter of asserted Claim 22 and the combination of the Vulcan method and the Tishken product (and the method by which it is made) are such that the subject matter as a whole would have been obvious in June, 1969, to one hav-

ing ordinary skill in the roll-forming and metal-bending art.

119. The Court concludes as a matter of law that the subject matter of asserted Claim 22 as a whole, in the context of the prior art on which defendants rely, would have been obvious to one having ordinary skill in the roll-forming and metal-bending method art—and asserted Claim 22 of the '088 "method" patent is invalid under 35 USC §103.

120. MSI challenges the propriety of "combining a machine with a product to invalidate method Claim 22." Defendants clearly rely upon the Vulcan method, not the machine, per se, and are entitled to rely upon the Tishken product, in view of the method step (e) of dependent Claim 22 including product limitations. Moreover, assuming arguendo that the use of the Tishken product per se, was improper, the Tishken product can be used to exemplify the method by which it was obviously made. In the context of Claim 22, defendants' combination of the Vulcan method and the Tishken product (and the method by which it is made) is proper, particularly since the Vulcan method discloses every claimed step, with the exception of step (e) dependent Claim 22 which calls for the side seam construction shown by the Tishken product.

121. The foregoing discussion of the legal authorities on obviousness and synergism relative to Claim 8 of the '903 "machine" patent is fully applicable to asserted Claim 22 and is incorporated by reference here.

122. The Court finds that all of the steps recited in asserted Claim 22 are old in the art, each performing its

own function independently of the others. Indeed, counsel for MSI admitted that he never specifically asked either one of MSI's experts about "synergism" (TT 1277-78). Neither reliance on the "free flow" method concept (*not* set forth in the '088 patent or any of its claims) nor reliance on "the steps that they took and the machine that they put together to produce that type of duct" satisfies MSI's burden of establishing "synergism" or a "synergistic effect" (TT 1277-78). Moreover, MSI has failed to adduce evidence in this record to establish the "synergism" required by the Supreme Court and the 7th Circuit Court of Appeals. The combination of steps recited in asserted Claim 22 does *not* produce a total greater than the sum of its parts—and does *not* produce a synergistic effect or result. In the case of asserted Claim 22, two plus two still equals four! Claim 4 is invalid for this reason.

123. The foregoing discussion of secondary considerations relative to Claim 8 of the '903 "machine" patent is fully applicable to Claim 22 and is incorporated by reference here.

124. The Court finds that the cumulative effect or impact of the above discussed secondary considerations, as well as other secondary considerations on which MSI relies, is not adequate to overcome or offset this Court's conclusion of obviousness based on the above discussed primary considerations or factors. Moreover, considering all of the primary and secondary considerations, de novo, the Court concludes that the subject matter of asserted Claim 8 as a whole would have been obvious in June, 1969, to a person having ordinary skill in the roll-forming or metal-bending method art. As such, asserted Claim 8 is invalid for obviousness under 35 USC §103.

Asserted Claim 4 Of the '830 "Duct" Patent Is Invalid For Obviousness Under 35 USC §103

125. As found previously by the Court, there are no real "differences" between the prior art relied upon by defendants and asserted Claim 4 of the '830 "duct" patent. Specifically, as discussed above, the Vulcan duct discloses all the subject matter of asserted Claim 4 except for the flange element extending into opposite portions of the lip element (as defined by the last part of dependent claim 4). However, in the context of the level of ordinary skill in the duct or air conduit art, the Court concludes that it would have been obvious to one having skill in this art in June, 1969, to deform the interlocking seam of the Vulcan duct so that the flange element extends into the opposite portions of the lip. The Court concludes, therefore, that any differences between the subject matter of asserted Claim 4 of the "380 "duct" patent and the Vulcan duct are such that the subject matter as a whole would have been obvious in June 1969, to one having ordinary skill in the duct or air conduit art, particularly in view of the level of ordinary skill discussed above, including particularly the Mayrath patent (DX-S). Hence, the Court finds that asserted Claim 4 is invalid under 35 U.S.C. §103.

126. Further, as found by the Court, there are no real "differences" between the combination of the Vulcan duct and the Tishken product and asserted Claim 4. In view of the Vulcan duct disclosing at least the subject matter of Claim 1 and the Tishken product disclosing substantially all of the subject matter of dependent Claim 4, the Court concludes that it would have been obvious to one having ordinary skill in the duct or air conduit art in June, 1969,

to modify the Vulcan duct to produce a duct having interlocking side seams wherein the flange element extends into the opposite portions of the lip element, as suggested (although perhaps not clearly taught) by the Tishken product, as defined by asserted Claim 4. The Court further concludes that any differences between the subject matter of asserted Claim 4 and the combination of the Vulcan duct and the Tishken duct are such that the subject matter as a whole would have been obvious in June, 1969, to one having ordinary skill in the duct or air conduit art.

127. The Court concludes as a matter of law that the subject matter of asserted Claim 4 as a whole, in the context of the prior art on which defendants rely, would have been obvious to one having ordinary skill in the duct or air conduit art—and asserted Claim 4 of the '830 "duct" patent is invalid under 35 USC §103.

128. The foregoing discussion of the legal authorities on obviousness and synergism relative to Claim 8 of the '903 "machine" patent fully is applicable to asserted Claim 4 and is incorporated by reference here.

129. The Court finds that all of the elements recited in asserted Claim 4 are old in art, each performing its own function independently of the others. Indeed, counsel for MSI admitted that he never specifically asked either one of MSI's experts about "synergism" (TT 1277-78). Neither reliance on the "free flow" method concept (*not* set forth in the '088 patent or any of its claims) nor reliance on the "steps that they took and the machine that they put together to produce that type of duct" satisfied MSI's burden of establishing "synergism" or a "synergistic effect" (TT 1277-78). Moreover, MSI has failed to adduce evidence

in this record to establish the "synergism" required by the Supreme Court and the 7th Circuit Court of Appeals. The combination of elements recited in asserted Claim 4 does *not* produce a total greater than the sum of its parts—and does *not* produce a synergistic effect or result. In the case of asserted Claim 4, two plus two still equals four! Claim 4 is also invalid for this reason.

130. The foregoing discussion of secondary considerations relative to Claim 8 of the '903 "machine" patent is fully applicable to Claim 4 and is incorporated by reference here.

131. The Court finds that the cumulative effect or impact of the above discussed secondary considerations, as well as other secondary considerations on which MSI relies, is not adequate to overcome or offset this Court's conclusion of obviousness based on the above discussed primary consideration or factors. Moreover, considering all of the primary and secondary considerations, de novo, the Court concludes that the subject matter of asserted Claim 4 as a whole would have been obvious in June, 1969, to a person having ordinary skill in the duct or air conduit art. As such, asserted Claim 4 is invalid for obviousness under 35 USC §103.

The Issue of Wilful Infringement

132. MSI additionally charges that defendants wilfully infringe the '903 "machine" patent, the '088 "method" patent and the '830 "duct" patent, primarily because defendant ADM copied MSI's machine. Defendants deny MSI's "wilful infringement" contention and rely upon letters from Mr. Edward Keating, a patent attorney, to Mr.

Pettyjohn of ADM (DX-YA, YB). Mr. Keatings initial letter of August 16, 1971 (DX-YA) indicates that Mr. Keating made an initial search in which he discovered patent No. 3,353,248. In reference to this patent, Mr. Keating stated that "I feel that this patent will prevent MSI from obtaining broad patent protection on their duct forming machine". Mr. Keating's subsequent letter of August 24, 1971 to Mr. Pettyjohn (DX-YB) indicates that Mr. Keating had completed his search "to determine if MSI will be able to obtain a valid United States patent on their duct forming machine". He concluded, "in my opinion, based on the foregoing search, *MSI will not be able to obtain a valid patent covering their duct forming machine*" (Emphasis added).

133. MSI further refers to the deposition testimony of Mr. Pettyjohn (PX-135), stating that Mr. Pettyjohn has no recollection of supplying their patent attorneys with any documents or things to show what the MSI machine was like nor that he had any recollection of ever talking with ADM's patent attorney, Mr. Keating (TT 985-986). The fact that Mr. Pettyjohn did not recall his discussion is irrelevant. The evidence shows that defendant ADM was provided with an opinion from its counsel that no valid patent could be obtained. Defendant ADM is entitled to rely on that opinion, for "no inference of bad faith can be drawn from the fact that Lincoln [ADM] procured an opinion from competent patent counsel. If anything, it shows that Lincoln [ADM] was making a good faith effort to avoid infringement" *Union Carbide Corp. v. Graver Tank & Mfg. Co., Inc.*, 282 F.2nd 653 (7th Cir. 1960). Such a good faith effort to avoid infringement "removes the infringement from the class designated as wanton and

willful", *Anderson Company v. Sears, Roebuck and Co.*, 265 F.2d 755, 763 (7th Cir. 1959). In view of the above, the Court finds that defendants would not be guilty of willful infringement, assuming there was infringement and the three patents in suit were valid, which they are not.

The Unenforceable Issue

134. Defendants contend that the '903 "machine" patent, the '688 "method" patent, and the '830 "duct" patent are each unenforceable, because of MSI's alleged misuse of the above patents and alleged unclean hands. In view of the Court's conclusion that the asserted claims of the patents in suit are invalid, the unenforceability issue is deemed to be moot.

CONCLUSIONS OF LAW

1. This Court has jurisdiction over the parties and over the subject matter of this suit. Venue is properly laid in this District.

2. Plaintiff, Manufacturers Systems, Inc., has title to Letters Patent No. 3,636,903, entitled "Rectangular-Duct Forming Machine", No. Re. 28,088, entitled "Method of Forming A Rectangular Heat Duct", and No. 3,757,-830, entitled "Rectangular Air Duct", and has the full right to bring suits thereunder.

3. Defendants ADM Industries, Inc., Indiana Tool & Manufacturing Co., Inc., Drexell (Rex) L. Simpson and AMS of Indiana, Inc., have maintained their burden of proving the essential facts in support of their defense of obviousness under 35 USC §103. The law is with defendants and against plaintiff on the issue of obviousness. Defendants are entitled to judgment on the Complaint.

4. Each of Claim 8 of U. S. Letters Patent No. 3,636,903, Claim 22 of U.S. Letter Patent No. 28,088 and Claim 4 of U. S. Letter Patent No. 3,757,830, is invalid for obviousness under 35 USC §103.

5. Every finding of fact deemed a conclusion of law is hereby adopted as a conclusion of law.

6. The entry of a final judgment under Rule 54(b) F.R.C.P. is appropriate, as there is no just reason for delay.

Dated February 16, 1978.

/s/ ROBERT A. GRANT
Judge

Order

It having come to the Court's attention that an error appears in the language of the Court's Memorandum filed February 16, 1978, *i.e.*, the word, "valid" in Paragraph 2, Line 6, of said Memorandum should read, "invalid", and the amended sentence should then read, "For reasons more particularly set forth below, we find that the plaintiff's patents in suit are invalid for obviousness, under 35 U.S.C. § 103."

IT IS ORDERED that said Memorandum entered February 16, 1978, be corrected accordingly and that this entry shall be made nun pro tunc as of the date of said Memorandum.

ENTER: February 22nd, 1978.

/s/ ROBERT A. GRANT
District Judge

APPENDIX-B

IN THE
UNITED STATES COURT OF APPEALS
FOR THE SEVENTH CIRCUIT

No. 78-1406

MANUFACTURERS SYSTEMS, INC.,

Plaintiff-Appellant,

v.

ADM INDUSTRIES, INC., INDIANA TOOL & MFG. CO., INC., DREXELL (REX) L. SIMPSON AND AMS OF INDIANA, INC.,

Defendants-Appellees.

Appeal from the United States District Court for the Northern District of Indiana, South Bend Division. Civil No. 72-S-102
Robert D. Morgan, *Judge.*

ARGUED NOVEMBER 6, 1978-
DECIDED JANUARY 19, 1979

Before FAIRCHILD, *Chief Judge,* TONE, and BAUER, *Circuit Judges.*

The District Court found that the patent claims asserted in this action by the appellant Manufacturers Systems' patents, Claim 8 of 3,636,903 (the machine patent),

Claim 22 of 28,088 (the method patent), and Claim 4 of 3,757,830 (the product patent) were invalid for obviousness under 35 U.S.C. §103, and therefore entered judgment for the defendants in Manufacturers Systems's infringement suit. The facts are set forth in the findings of the District Court and will not be repeated here. For the reasons stated below, we affirm the judgment.

I.

The District Court found that the Vulcan, Wogerbauer, and Lockformer machines, methods, and products and the Tishken method and product were all prior art relevant to the patents in suit. Manufacturers Systems asserts in various ways throughout the argument that none of this prior art is relevant to any of those patents, because it relates to products different from the ducts which are the subject of those patents. The introductory paragraph of each of the patents refers to a specific kind of duct: "heat duct" (machine patent), "air duct" (method patent), and "heating, cooling, and ventilating air conduit" (product patent). The Vulcan machine and method produce porch enclosure frames. The Wogerbauer machine and method produce "fold flange tubing," which is used to make doors, windows, and frames. The Lockformer machine and method produce "locks" used to connect sections of heating duct. The Tishken method produces tubing used in automobile air conditioner condensers. We agree with the District Court's conclusion that this prior art is relevant to the patents in issue nere.

The problems associated with producing

a rectangular duct from two continuous sheets of metal that the teaching of the patents in suit was said to overcome were not unique to rectangular duct used for heating and ventilating. *Cf.*, *e.g.*, Exhibits, Book 1, 34. Whatever the intended end-use the problems would be similar, if not identical; therefore, the relevant art would include machines and methods for forming and bending metals. *Cf. Graham v. John Deere Co.*, 383 U.S. 1, 35 (1966). (Container lids for liquid containers having pouring spouts relevant to similar lids for containers with pump sprayers.) As the District Court found, "the Patent Office ... cited against the machine and method patents in suit, at least four patents disclosing machines and methods for making products *other* than heat ducts." App. at 59 (Emphasis in original.) Indeed, the applicants "called to the attention of the Patent Office patents disclosing machines for making products other than heat ducts ... and never characterized them as 'non-analogous.'" *Id.* at 60. Finally, as to the product patent, we note that the applicants attempted to amend the claims by "restrict[ing] the invention to the heating, cooling and ventilating fields [because] the broader form of the invention as presently covered by claim 14 [product patent claim 1] ... would cover, in effect, any conduit capable of conveying air, irrespective of its size or configuration." Exhibits, Book 1 at 103. The Patent Office entered the proposed amendment as "to matters of form not affecting the scope of the invention." *Id.* at 104.

We do not think that any of these facts determine the scope of the pertinent art or estop Manufacturers Systems from

contending that the relevant art is limited to machines and methods for producing heating or ventilating duct or that the relevant art as to the product patent is heating and ventilating duct. Nevertheless, that neither the Patent Office nor the applicants thought that the relevant art was limited to these areas at the time the patents were issued supports our conclusion that for the purposes of 33 U.S.C. §103 the relevant art includes machines and methods for producing metal duct, whatever the intended use of the product. *See Graham v. John Deere Co.*, *supra*, 383 U.S. at 35-36, n.18; *Mandel Brothers v. Wallace*, 335 U.S. 291, 294-296 (1948); *Cuno Engineering Corporation v. Automatic Devices Corporation*, 314 U.S. 84, 88-89 (1941).

Manufacturers Systems vigorously asserts that the District Court erred in not requiring the defendants to meet a standard of proof higher than clear and convincing in order to establish that the Vulcan machine, method, and product were prior to the alleged inventions of the patents. This argument seems to be based on the assumptions that before the Vulcan machine can be considered as prior art for purposes of §103, it must first be shown to be within §102(a) or (g), and that under those provisions proof must be such as to leave no reasonable doubt. Plaintiff cites *Pleatmaster, Inc. v. J. L. Golding Mfg. Co.*, 240 F.2d 894, 898 (7th Cir. 1957). The passage in *Pleatmaster* relied upon dealt with establishing a date of invention, earlier than the date on which the inventor applied for a patent. The Vulcan machine, method, and product were not claimed to be inventions but simply prior uses, so §102(g) has no relevance. Assuming §102(a) were involved here, *see*

National Rolled Thread Die Co. v. E. W. Ferry Screw Products, Inc., 541 F.2d 593, 596 (6th Cir. 1976), there would be no reason to differentiate between the standard of proof under that subsection and the standard under §102(b), *id.*, which is clear and convincing evidence. *Red Cross Manufacturing Corp. v. Toro Sales Co.*, 525 F.2d 1135,1139 (7 Cir. 1975). That is also the standard under §103. *See, e.g., Chicago Rawhide Manufacturing Co. v. Crane Packing Co.*, 523 F.2d 452, 457-458 (7th Cir. 1975), *cert. denied*, 423 U.S. 1091 (1976). The evidence presented to the District Court, though primarily oral, was sufficient to meet this burden of proof, and therefore the court's findings that the Vulcan machine, method, and product were prior to the alleged invention in suit are not clearly erroneous.

II.

Both the method patent and the product patent are based in part on the machine patent. The only claim of the machine patent in issue is Claim 8.[1] The District

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1. Claim 8 reads as follows:

[1.] A rectangular heat duct former capable of continuously forming a rectangular duct of conventional heat duct cross-sectional dimensions and of any appreciable length from pairs of rectangular sheets of metal, limited only by the length of such sheets, as they pass therethrough, comprising:

a. an elongated frame,

b. rectangular duct-forming mechanism carried by said frame and constructed and arranged to continuously form in progressive stages ducts which have rectangular heat duct cross-sectional

Court found that the Vulcan machine teaches the continuous formation of rectangular

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1. (continued)
dimensions and configuration from pairs of such rectangular sheets of metal as they pass through said mechanism, said duct-forming mechanism including:
1. two series of successive pairs of cooperative rotary die members,
2. each of said series being disposed along one of a pair of spaced metal-sheet paths extending longitudinally of said frame,
3. said pairs of cooperative rotary die members of each of said series being mounted for rotation upon said frame at spaced locations along the length of said frame and being constructed and arranged to engage the lateral portions of such sheets at each side thereof to cooperatively and progressively shape each of such pairs of sheets into an elongated rectangular duct as they pass longitudinally through said mechanism,
4. some of said pairs of cooperative rotary die members being also disposed at locations spaced transversely of said frame at opposite sides of such sheets in position to engage them at their lateral portions as they pass through said mechanism and
5. progression means supported adjacent said series of rotary die members and constructed and arranged to engage and move a pair of such sheets of metal longitudinally through said mechanism in spaced

duct by feeding two sheets of metal through an upper and lower series of successive pairs of cooperating rotary die members, which are spaced along the frame of the machine and which generally shape and bend the lateral edges of the sheets toward each other until the edges interlock. App. 52-54. The court also found that the Vulcan machine teaches and discloses the use of a crimping mechanism to further secure the lateral edges of the duct, camming members to assist in moving the metal through the machine, and a fixed die member to assist in shaping the metal. *Id.* 70. The Wogerbauer patent discloses a similar machine; the lateral edges of the

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1. (continued)
relation to each other and in position to be engaged at their lateral portions and so shaped by said cooperative rotary die members.

[8] The structure defined in claim 1, wherein said duct-forming mechanism also includes:

6. A fixed die member carried by said frame and extending longitudinally thereof, and

7. a plurality of camming members mounted on said frame adjacent said fixed die member and constructed and arranged with respect thereto to engage and cooperatively shape lateral portions of such sheets as the latter pass longitudinally through said mechanism and thereby form such sheets progressively along their lengths into a duct having a rectangular configuration.

Exhibits, Book 1, 18-19.

duct, however, are welded rather than crimped. *Id.* 55-5. The Lockformer machine also teaches the use of a fixed die member and a plurality of camming members to cooperate with the die member in moving and shaping the metal; the Lockformer product is not continuously formed or rectangular. *Id.* 56-57.

The District Court found that there were no significant differences between Claim 8 of the machine patent and the Vulcan machine, the Vulcan and Lockformer machines, or the Wogerbauer and Lockformer machines. App. at 70.

The District Court also found that each element in claim 22 of the method patent,[2] the only claim of that patent at

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2. Claim 22 of the patent reads as follows:

[1] A method of forming a rectangular air duct in a single continuous operation consisting in:

a. providing a pair of elongated flat metal sheets in spaced parallel relation,

b. progressively crimping the inner lateral portions at each side of each of said sheets longitudinally from one of its ends toward the other along a corner line to facilitate bending of the lateral portions of each of said sheets toward the corresponding lateral portions of the other,

c. bending simultaneously the lateral portions of such sheets toward each other progressively in increments along their lengths until the lateral portions of one of such sheets abuts the lateral portions of the other throughout their lengths and

issue, was disclosed in the Vulcan method except the bending of the lateral edges of the duct to form 90 degree angles, and that the method of such bending was disclosed in the Tishken method. App. 76.

We find the District Court's findings of fact not to be clearly erroneous. Nor, where the asserted differences between the prior art and the claimed invention are as tenuous as those asserted here, can we

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2. (continued)
a rectangular configuration in cross-section is thereby defined, and
d. progressively forming an interlocking seam in the abutting lateral portions of such sheets from a point adjacent one of their ends toward the other to positively lock and maintain such sheets in a cooperative rectangular duct-defining relation.

[22] The method defined in Claim 1 where said bending operation includes camming the the lateral portions of such sheets toward each other progressively in increments along their lengths, and
e. progressively bending the outer lateral portions of said sheets longitudinally along seam lines so as to cause said outer lateral portions to extend substantially normal to their adjacent inner lateral portions and parallel to and in abutting relation in part at least to each other when the rectangular configuration has been defined.

Exhibits, Book 1, 53-54.

conclude that the court commited an error of law. In short, we are unpersuaded that the combination of old elements in the machine and method patents represent the result of anything more than ordinary skill in the art.

In the District Court, Manufacturers Systems argued that there were several significant differences between what was disclosed in the prior art and claims 8 and 22 of the machine and method patents. On appeal, Manufacturers Systems primarily relies on (1) the different end uses of the products of the prior art machines and methods and (2) the "synergistic" effect of the so-called "free-flow" concept. We have already rejected the contention that different product end uses render the prior machine and method technology irrelevant or nonanalogous art. We also reject the similar conteniton that application of old art in a new field is sufficient to sustain the validity of either the machine or method patent. *See Cuno Engineering, supra*, at 91-92; *Pennsylvania R. Company v. Locomotive Engine Safety Truck Company*, 110 U.S. 490, 4 S.Ct. 220, 222 (1884). Except for the alleged synergism resulting from the "free-flow" concept, Manufacturers Systems does not point to anything that differentiates the manner in which the elements of its machine and method operate to produce heating duct from the manner in which those elements in the Vulcan machine and method operate to produce porch enclosure frames. Therefore, unless the "free-flow" concept saves them, both Claim 8 of the machine and Claim 22 of the method patents are invalid, for they represent nothing more than the combination of several elements, each well

known and functioning in the same way it always did to produce heat duct. *See id.; Concrete Appliances Co. v. Gomery*, 269 U.S. 177, 184-185 (1925).

Manufacturers Systems contends that although the "free-flow" concept is not mentioned anywhere in any of the patents, it is adequately disclosed in the machine patent specifications and drawings. Granting that patent claims, like other written statements, should be read in light of the context in which they are made, *cf. United States v. Adams*, 383 U.S. 39, 49 (1966); *Graham v. John Deere*, *supra*, at 33-34, the alleged free-flow concept or effect is nevertheless not claimed. Even if we could allow the claims to be expanded by the specifications and drawings relied upon by Manufacturers Systems to support the "free-flow" concept, we would find them insufficient to bear the construction Manufacturers Systems attempts to give them. Thus, even if the "free-flow" concept would have been sufficient to sustain the patents, it cannot be relied on here, for it is not claimed and is not even disclosed or indicated in the specifications or drawings. Indeed, the "free-flow" concept appears to be an afterthought. Even though both the machine and method patents were initially rejected on the basis of prior art, no reference to this "free-flow" concept was ever made by the applicants. In rejecting a similar argument in *Graham v. John Deere*, *supra*, the Court said, "If this were so vital an element in the functioning of the apparatus, it is strange that all mention of it was omitted." *Id.* at 25. It is stranger still where, as here, the applicants made no mention of this element of the invention after the patent office had rejected the initial application.

Two other arguments concerning the method patent should be briefly mentioned. Manufacturers Systems asserts two related grounds for distinguishing the Vulcan method. First, the metal sheets that are fed into the Vulcan machine are not in "spaced parallel relations," as called for in Claim 1(a) of the patent. Second, the metal sheets that are fed into the Vulcan machine are too far apart to be bent toward each other until the lateral edges are brought into an "abutting relation," as called for in Claim 22(e) of the patent. The District Court rejected the first contention: "Although the Vulcan sheets are not exactly parallel, they are substantially parallel and, at least in a functional sense, satisy the parallel claim language." App. at 72. We agree with that conclusion, for minor adjustments made in the relationship of the sheets to each other are not sufficient to establish non-obviousness. The District Court does not appear to have addressed the second contention. If plaintiff failed to make the argument in the trial court, that alone would be sufficient reason for us to reject it. Moreover, the only difference between the Vulcan method and the method patent that would be established if the second contention is accepted is that in the Vulcan method the two sheets are moved closer together as the lateral edges are shaped and before the crimping stage. That difference is not sufficient to make the method patent non-obvious in light of the Vulcan method.

Claim 4 of the product patent[3] is

3. Claim 4 reads as follows:
[1] A rigid non-collapsible rectangular

also invalid for obviousness. The District Court found that each of the elements in

3. (continued)

heating, cooling, and ventilating air conduit as conventionally used in the heating, air conditioning and ventilation fields comprising:

a. a pair of elongated metal sheet members of substantially equal length.

b. the lateral portions of at least one of said members having been bent progressively inwardly at right angles toward the other of said sheet members and meeting lateral portions thereof and cooperatively defining therewith a rigid non-collapsible heating, cooling and ventilating air duct having a rectangular interior when considered cross-sectionally,

c. the corresponding lateral portions of said sheet members cooperatively constituting a pair of longitudinally extending seams, one each of which is disposed at opposite sides of the conduit,

d. each of said seams being comprised of a sealing flange element carried by the lateral edge portions of one of said members and a lip element carried by the corresponding lateral edge portions of the other of said sheet members,

e. said lip extending along opposite sides and around the edge of said flange element,

g. each of the portions of said lip element disposed at opposite sides of said flange element and the portion of said flange element disposed therebetween being cooperatively deformed at spaced locations along the length of said seams to seal and interlock

Claim 4 of the product patent is disclosed in the Vulcan and Tishken products. The differences in end uses for the products are, as we have said, immaterial. Although several other distinctions were asserted and rejected in the District Court, Manufacturers Systems now relies only on the lack of evidence to show that the deformations in either the Vulcan product or the Tishken product extend through the flange element of the lateral edge into the lip element of the edge. Assuming that to be true, we cannot conclude that the product patent is valid. It is obvious to us, and would certainly be so to one skilled in the art, that if it was thought desirable to have the deformations extend through the flange element and into the lip element, more pressure would produce that result.

Manufacturers Systems asserts that the District Court failed to properly consider the secondary factors described in *Graham v. John Deere*, *supra*, but does not explain what the court should have done that it did not do. Presumably, the court considered the "secondary tests"

3. (continued)

said elements and thereby secure said sheet members to each other in interlocking conduit-defining relation.

[4] The structure defined in Claim 1 wherein at each of said deformations, portions of said lip element extend into the plane of said flange element and portions of said flange element extend into the opposite portions of said lip element.

Exhibits, Book 1, at 84.

indicated in Manufacturers Systems' proposed findings of fact and conclusions of law. In any event, when a patent is invalid for obviousness, the secondary factors described in *Graham v. John Deere* cannot make it valid. *See id.* at 35-37.

Manufacturers Systems complains of the District Court's "mechanized adoption of the proposed findings" prepared by defendants. Uncritical adoption of findings and conclusions submitted by the prevailing party has met with our criticism in the past. *E.g., F. S. Services, Inc. v. Custom Farm Services, Inc.*, 471 F.2d 671, 676 (7th Cir. 1972). Nevertheless, if the material facts are set forth and they are not clearly erroneous, they should be affirmed. *See id.*; Rule 52, Federal Rules of Civil Procedure; *see* generally 5A *Moore's Federal Practice* ¶ 52.06[1], at 2710 (1978). Here, it appears from the district judge's memorandum adopting the findings and conclusions that the judge "thoroughly and carefully studied and considered" them and was satisfied with their accuracy and merit before adopting them. We are satisfied that the findings and conclusions represent his views.

The judgment of the District Court is affirmed.

AFFIRMED.

UNPUBLISHED ORDER NOT TO BE CITED PER CIRCUIT RULE 35

APPENDIX-C

In the

United States Court of Appeals

For the Seventh Circuit

No. 77-1872

REPUBLIC INDUSTRIES, INC.,

Plaintiff-Appellant,

v.

SCHLAGE LOCK COMPANY,

Defendant-Appellee.

Appeal from the United States District Court for the Southern District of Illinois, Peoria Division.
Mo. P-Civ-76-17—**Robert D. Morgan**, *Judge.*

ARGUED JUNE 5, 1978—DECIDED FEBRUARY 1, 1979

Before SWYGERT, CUMMINGS, and PELL, *Circuit Judges.*

SWYGERT, *Circuit Judge.* Republic Industries, Inc., assignee and owner of the Slaybaugh patent, U.S. Patent No. 3,852,845, instituted this infringement action against Schlage Lock Company. Schlage counterclaimed, alleging invalidity of the patent and noninfringement. Without reaching the infringement issue, the district court in a thorough opinion held the Slaybaugh patent invalid for obviousness under 35 U.S.C. § 103 and entered judgment for defendant. *Republic Industries, Inc. v. Schlage Lock Co.*, 433 F. Supp. 666 (S.D. Ill. 1977). We affirm.

This appeal presents a recurrent problem: the proper criteria by which a combination patent is measured for nonobviousness. Increasingly, the districts courts in this circuit, not without some confusion emanating from this court, have taken the view that synergism and not the criteria articulated in *Graham v. John Deere Co.*, 383 U.S. 1 (1966), is the controlling test in combination patent claims.[1] Before addressing this question, we review the claims of the patent involved in this appeal.

I

The Slaybaugh patent comprises nine claims. Claims 1 through 7 of that patent were not placed in suit by Republic; only claims 8 and 9 are alleged to be infringed. Since Republic concedes that the validity of claim 9 is dependent upon the validity of claim 8, only the latter claim will be discussed.[2]

The invention of Slaybaugh's claim 8 is a door closer used to hold open and to close fire doors in hospitals, institutional health care facilities, and other public buildings. Republic argues that the Slaybaugh device achieves a unique combination of two functions in a single unit: (1) multiple-point hold-open, whereby a door can be held open at any point along the arc between its closed and fully opened positions; and (2) momentary manual release, whereby a door in any open position becomes self-closing when a person momentarily pushes or pulls the door.[3] The Slaybaugh patent was

[1] *See, e.g., A. F. Dormeyer Manufacturing Co. v. International Components Corp.*, (No. 76 C 2134 (N.D. Ill., June 8, 1978); *Harig Products, Inc., v. K. O. Lee Co.*, 195 U.S.P.Q. 292 (N.D. Ill. 1977); *Saunders v. Air-Flo Company*, 435 F. Supp. 298 (N.D. Ind. 1977); *Republic Industries, Inc. v. Schlage Lock Co.*, 433 F. Supp. 666 (S.D. Ill. 1977).

[2] Claim 9 simply provides: "The combination of claim 8 wherein said means for resiliently holding said valve are electrically operated."

[3] The momentary manual release feature thereby differs from manual release in that the latter is not self-closing, requiring manual force to close the door completely. Although

(Footnote continued on following page)

the first device in the history of door closers which combined these two features.

As illustrated by the schematic diagram below, claim 8 of the Slaybaugh device is essentially comprised of seven elements, each of which Republic concedes to be old and known:[4]

(1) a door-closing main spring;

(2) a piston geared to the door and sliding within an enclosed cylinder, which is activated by the main spring;

[3] *continued*
the manual release feature is often connected to an electrical control circuit such as a smoke detector which, when activated, will close the door, the unique aspect of the momentary manual release feature, Republic argues, is that fire doors can be closed quickly and easily regardless of smoke-detector operation, *e.g.*, when a detector might fail to operate.

[4] Claim 8 claims as invention:

> A combined door check and door hold open device including resilient means for urging a door toward closure upon expansion thereof, means defining a hydraulic cylinder, a piston therein connected to move toward one end of said cylinder with the expansion of said resilient means, said resilient means establishing a pressure per unit area on fluid ahead of said piston, means associated with said one end of said cylinder defining a passage for the escape of fluid from said one end having a valve seat therein, a valve adapted to close against said valve seat from the downstream side thereof, said valve having a face larger than said valve seat, a valve chamber downstream of said seat, a portion of said valve downstream of said face closely contained in said chamber to substantially prevent fluid flow past said valve and allow a pressure drop across said valve when said valve is open, means providing a fluid escape passage opening into said valve chamber upstream of said valve face at an open position of said valve, means providing a fluid escape passage from said valve chamber behind said closely contained portion of said valve when in said open position, and means adapted to hold said valve resiliently against said seat with a force in excess of the product of said pressure and said valve seat area and less than the product of said pressure and said face area.

(3) hydraulic fluid[5] in the cylinder ahead of (in the diagram, to the right side of) the piston;

(4) a fluid escape passage to the right of the piston;

(5) a dual area valve[6] which closes the fluid escape passage;

(6) a solenoid[7] which, by exerting a force on the valve, maintains the valve in a closed position overcoming the opposing force of the door-closing spring; and

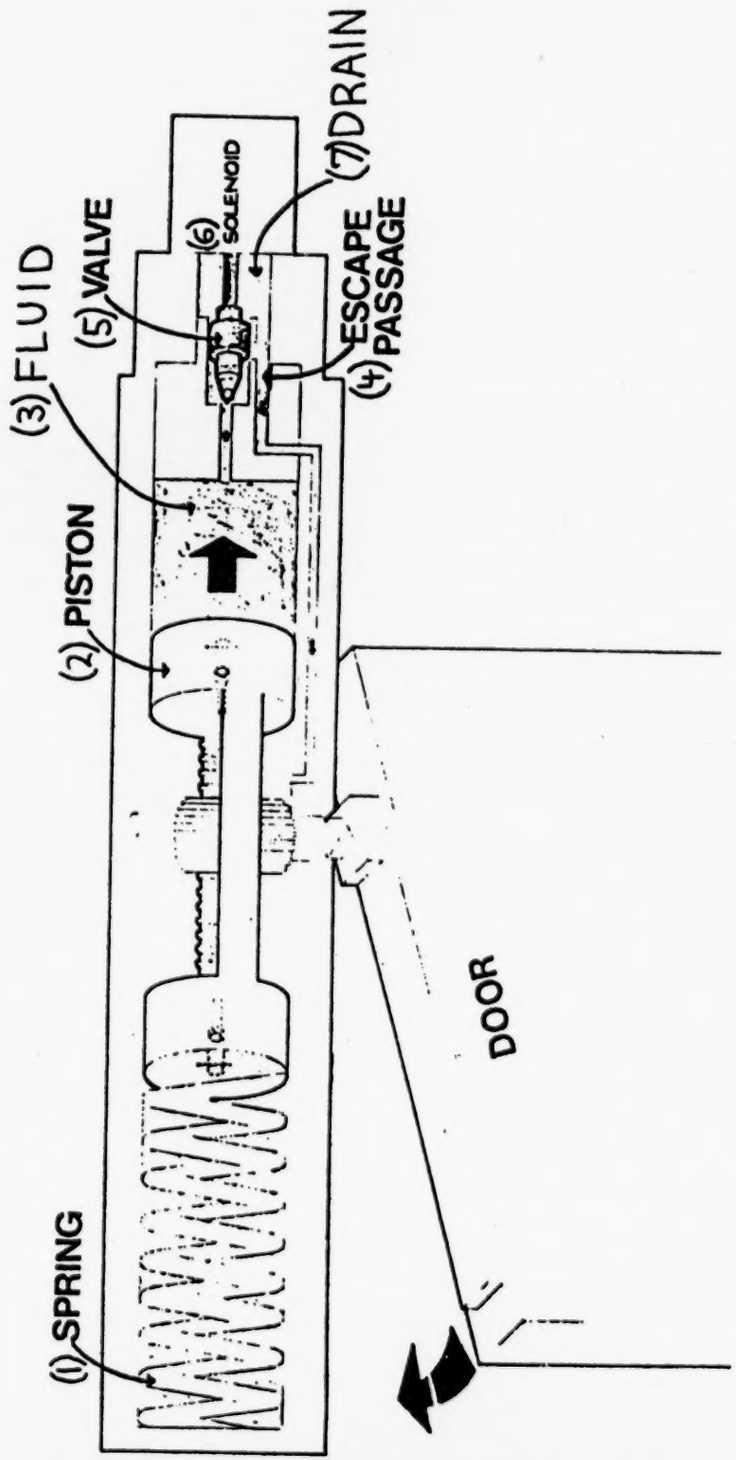
(7) a drain behind the dual area valve to insure free valve movement, since accumulation of fluid behind the valve would block or interfere with valve movement.

In its commercial embodiment, Republic's unit, called *Fire Eye II MR*, is completely encapsulated.

[5] Hydraulic fluid in a door closer is the liquid, typically oil, which flows within the door closer cylinder to provide door opening and closing speed control as well as to provide lubrication for the moving mechanical parts of the unit.

[6] A valve is a device in a passage that regulates fluid flow by opening or blocking the passage with a movable member. A dual area valve functions the same way, except that the valve has two faces, each a different size.

[7] A solenoid is a device which uses electrical energy to create a magnetic field in a coil so that a movable core is drawn into the coil when a current flows. Here the solenoid is attached to the dual area valve.



As the door is opened to any desired position (the multiple-point hold-open feature), a gear mechanism attached to the door causes the piston in the diagram to move to the left, thereby compressing the closing spring. The electrically controlled solenoid exerts a force on the valve to close off the fluid escape passage, thus preventing the fluid interposed between the piston and valve from escaping. Even though the closing spring is urging the piston toward the right, movement of the piston is blocked because fluid cannot escape from its chamber through the fluid escape passage when the valve is closed. The door remains open as long as the equilibrium between the opposing forces of the spring and solenoid is maintained.

An open door may be closed either automatically or manually. The door is closed automatically by deactivation of the solenoid. The solenoid is connected to an external circuit which usually includes smoke or fire detectors. When the circuit is opened, *e.g.*, by the triggering of the smoke detector, the solenoid releases the force on the valve, thereby unseating it. Once the valve is open, the closing spring forces the piston rightward. The piston in turn forces the hydraulic fluid (interposed between the piston and the valve) past the valve through the escape passage. The gear mechanism attached to the piston swings the door toward closure.

The allegedly unique feature of the Slaybaugh patent is the momentary manual release. Unlike prior door closers which required manual assistance,[8] the Slaybaugh device requires only a brief pull or push on the door, whereby the door closes by itself. The force of the momentary pull together with the force of the closing spring are sufficient to overcome the solenoid's effect and unseat the valve, which, when open, allows the door to close by itself.

[8] In the case of manual operation, the force of the manual pull on the door, transmitted through the gear mechanism, supplements the preexisting force of the closing spring. The combined resultant force moves the piston rightward. This piston movement generates sufficiently high pressure in the fluid chamber to the right of the piston to overcome the force of the solenoid and unseat the valve.

II

Schlage contends that the Slaybaugh device is invalid because it is merely a combination of old elements having no synergistic effect. It takes this position regardless of whether a synergism test is defined in terms of a combination that produces an unexpected, unpredictable, or surprising result or in terms of individual elements of a combination functioning in a new and different manner. Although it is unclear whether Schlage understands synergism to be a substitute for or an addition to the statutory requirement of nonobviousness as interpreted in *Graham v. John Deere Co.*, 383 U.S. 1 (1966), it nonetheless argues that synergism is required by the *Anderson's-Black Rock v. Pavement Co.*, 396 U.S. 57 (1969), and *Sakraida v. Ag Pro, Inc.*, 425 U.S. 273 (1976), decisions. A review of these cases, particularly when placed in historical context, demonstrates otherwise.

The Patent Act of 1793 required that a device had to be both new and useful to be patentable. Act of February 21, 1793, ch. XI, § 1, 1 Stat. 318. Thereafter a third criterion was judicially created: a device had to be an "invention" as well.[9] Defining "invention" proved to be elusive. Nearly a century ago, the Supreme Court said as much about the term:

> The truth is the word cannot be defined in such manner as to afford any substantial aid in determining whether a particular device involves an exercise of the inventive faculty or not. In a given case we may be able to say that there is present invention of a very high order. In another we see that there is lacking that impalpable something which distinguishes invention from simple mechanical skill. Courts adopting fixed principles as a guide, have by a process of exclusion determined that certain variations in old devices do or do not involve invention; but whether the variation relied

[9] It is generally recognized that *Hotchkiss v. Greenwood*, 52 U.S. (11 How.) 248 (1851) is the earliest statement of the requirement of "invention."

> upon in a particular case is anything more than ordinary mechanical skill is a question which cannot be answered by applying the test of any general definition.

McClain v. Ortmayer, 141 U.S. 419, 427 (1891). The imprecision of the "invention" standard resulted in an inconsistent and unpredictable body of law because it required that the decision of patentability be based ultimately upon the subjective whims of the reviewing court.[10]

Congress revised the patent laws in 1952.[11] The novelty and utility requirements were maintained and recodified. 35 U.S.C. §§ 101, 102. The retention of these requirements did not, however, completely define the concept of patentability; missing was that essential quality which goes beyond mere newness or usefulness—the "something" that the courts had unsuccessfully strived for by the use of the term "invention." In order to start afresh in a semantic sense and to promote uniformity in the application of the patent laws, Congress added section 103.[12] That provision replaced

[10] In this regard, Judge Rich, one of the coauthors of section 103, stated:

> In the final analysis, all it amounted to was that if the court thought the invention, though new and useful, was not patentable, then it did not involve "invention" and vice versa. The requirement for "invention" was the plaything of the judges who, as they became initiated into its mysteries, delighted to devise and expound their own ideas of what it meant; some very lovely prose resulting.

Principles of Patentability, 28 Geo. Wash. L. Rev. 393, 404 (1960).

[11] Patent Act of 1952, ch. 950, 66 Stat. 798, *codified in* 35 U.S.C. §§ 101 *et seq.*

[12] The Reviser's note to section 103 provides:

> There is no provision corresponding to the first sentence explicitly stated in the present statutes, but the refusal of patents by the Patent Office, and the holding of patents invalid by the courts, on the ground of lack of invention or lack of patentable novelty has been followed since at least as early as 1850. This paragraph is added with the view

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the judically imposed requirement of "invention" with that of "nonobviousness":[13]

> A patent may not be obtained . . . if the differences between the subject matter sought to be patented and the prior art are such that the subject matter as a whole would have been obvious at the time the invention was made to a person having ordinary skill in the art to which said subject matter pertains. Patentability shall not be negatived by the manner in which the invention was made.

35 U.S.C. § 103.

Section 103 received its definitive interpretation in *Graham v. John Deere Co.*, 383 U.S. 1 (1966). There, the Court, in calling for "strict observance" of its requirements, laid out the analysis to be followed in cases involving the obviousness standard:

> While the ultimate question of patent validity is one of law [citation omitted], the § 103 condition, which is but one of three conditions, each of which must be satisfied, lends itself to several basic factual inquiries. Under § 103, the scope and content of the prior art are to be determined; differences between the prior art and the claims at issue are to be ascertained; and the level of ordinary skill in the pertinent art resolved.

Id. at 17. It is against this backdrop that *Black Rock* and *Sakraida* must be read.

[12] *continued*

> that an explicit statement in the statute may have some stabilizing effect, and also to serve as a basis for the addition at a later time of some criteria which may be worked out.

See also H.R. Rep. No. 1923, 82d Cong., 2d Sess. 7 (1952), quoted in *Graham, supra*, 383 U.S. at 15.

[13] Under the 1952 Act, the word "invention" was statutorily defined as any "invention or discovery." 35 U.S.C. § 100(a). Thus, an invention which is novel, useful and nonobvious is a patentable invention; a device which is lacking one or more of the criteria is an unpatentable invention.

Black Rock involved a combination patent in which each of the elements were known in the prior art.[14] In that case the Court recited that it would adhere to the guidelines it had developed in *Graham*. 396 U.S. at 61-63. Using such analysis, the Court held the patent at issue invalid because "the combination was reasonably obvious to one with ordinary skill in the art." *Id.* at 60. Although during the course of its discussion the Court noted that a combination "may result" in a synergistic effect,[15] the Court went on to hold that the device in question "was not an invention by the obvious-non-obvious standard," *id.* at 63; this phrase could only refer to *Graham* and section 103.

Similarly in *Sakraida*, the Court scrutinized the combination patent in issue by considering the scope and content of the prior art together with the differences between that art and the claimed invention.[16] In holding the patent invalid, the Court held: "[T]his particular use of the assembly of old elements would be obvious to any person skilled in the art of mechanical application." 425 U.S. at 282. Although the Court again discussed synergism, it is apparent from the context of the opinion that the Supreme Court raised the topic only in response to the court of appeals' assertion that synergism was present; the Court simply did not agree that the effect

[14] The claimed invention in *Black Rock* was the placement of a radiant-heat burner, a bituminous paving machine, and an asphalt shaper apparatus on one chassis. All three elements were old in the paving art. The alleged contribution was the combining of these three elements into a single paving machine.

[15] The extent of the Court's discussion of synergism was limited to two sentences: "A combination of elements may result in an effect greater than the sum of the several effects taken together. No such synergistic result is argued here." 396 U.S. at 61.

[16] The patent in *Sakraida*, a device designed to remove animal wastes from a dairy barn, involved the combination of a graded floor, flush troughs, and a means for storing water for a flood-effect release onto the barn floor.

produced by the claimed invention in that case was synergistic.[17]

Neither *Sakraida* nor *Black Rock* can be cited as prescribing some other, special test for the evaluation of combination claims. Nowhere in these two decisions did the Court hold a synergistic effect to be a necessary condition of patentability; nor did it hold that synergism supersedes a finding of nonobviousness under the *Graham* analysis. To the contrary, each case quoted *Graham* with approval. Each turned on whether the claimed invention was nonobvious on the basis of the three-pronged test in *Graham*. In short, we believe that *Sakraida* and *Black Rock*, rather than establishing an additional, different, or substituted test for nonobviousness under section 103, reaffirmed the continuing vitality of *Graham*.[18]

The district court, while agreeing that *Black Rock* and *Sakraida* did not establish synergism as a requisite to patentability, nonetheless interpreted cases from this court as requiring that every combination invention must have a synergistic effect to be patentable.

[17] The Fifth Circuit in *Sakraida* had held that the invention in issue "[did] achieve a synergistic result." 474 F.2d 167, 173 (5th Cir. 1973). To this conclusion the Supreme Court responded: "We cannot agree that the combination of these old elements . . . can properly be characterized as synergistic . . . ." 425 U.S. at 282. It is thus apparent that the reference to synergism arises not as a statement of an affirmative requirement of patentability, but rather as a rejection of the Fifth Circuit's holding.

[18] We believe our view is supported by the Court's action in *Dann v. Johnson*, 425 U.S. 219 (1976), decided just three weeks before *Sakraida*. In *Dann*, the briefs of the petitioner and one of the *amici* argued that synergism is essential for patentability and that the patent in issue was not synergistic. *See* Brief of Petitioner at 29; Brief of *Amici Curiae* for the Computer & Business Equipment Manufacturers Ass'n at 9. Importantly, the Court did not discuss, nor did it even mention, synergism. Instead, the claimed patent in that case was evaluated exclusively under the *Graham* pattern of analysis. 425 U.S. at 226-30.

The synergism test necessarily involves a two-pronged hypothesis: (1) the subject matter of the patent claim comprises a combination of several elements, each of which was known in the prior pertinent art, and (2) the combination is synergistic or at least produces a synergistic "effect." One premise of this hypothesis, at least as applied to mechanical or hydraulic devices, is that all such inventions are merely new applications of known elements and materials in different combinations. As Judge Learned Hand observed:

> It is idle to say that combinations of old elements cannot be inventions; substantially every invention is for such a "combination": that is to say, it consists of former elements in a new assemblage.

Reiner v. I. Leon Co., 285 F.2d 501, 503 (2d Cir. 1960), *cert. denied*, 366 U.S. 929 (1961).[19] If this be true (and if new nonobvious combinations are not patentable), then almost nothing would be patentable. *See Reeves Instrument Corp. v. Beckman Instruments, Inc.*, 444 F.2d 263, 270 (9th Cir.), *cert. denied*, 404 U.S. 951 (1971).

Once it has been determined that all of the elements in the combination are known, the next inquiry under the synergism approach is whether the claimed patent is synergistic or produces a synergistic effect. This has been no easy task. Courts have long wrestled with the meaning of synergism and have formulated a number of definitions. The two most common have been that one of the elements functions differently in combination than it did previously, *e.g., Burland v. Trippe Manufacturing Co.*, 543 F.2d 588, 592 (7th Cir. 1976), and that the combination results in an effect greater than the sum of the several parts taken separately. *E.g., St. Regis Paper Co. v. Bemis Co.*, 549 F.2d 833, 838 (7th Cir.), *cert. denied*, 434 U.S. 833 (1977).[20] A realistic appraisal of

[19] *See also Safety Car Heating & Lighting Co. v. General Electric Co.*, 155 F.2d 937, 939 (2d Cir. 1946); *Ruben Condensor Co. v. Copeland Refrigeration Corp.*, 85 F.2d 537, 541 (2d Cir. 1936), *cert. denied*, 300 U.S. 665 (1937).

[20] Other definitions have included: the elements must take on a surprising quality, *Gettleman Manufacturing, Inc. v. Lawn 'N' Sport*, 517 F.2d 1194, 1199 (7th Cir. 1975); the combination

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these formulations, however, reveals that synergism is only a figure of speech, for in its literal sense synergism never has existed and never can exist in mechanical or hydraulic inventions when the term is defined as a whole result greater than the sum of its constituent parts.[21]

There is, in fact, no such thing as a mechanical or hydraulic element functioning differently in combination than it did outside the combination. A spring or valve will always function as a spring or valve, alone or in concert with other components.[22] Moreover, mechanical elements can do no more than contribute to the combination the mechanical functions of which they are inherently capable. *See Application of Menough*, 323 F.2d 1011, 1015 (C.C.P.A. 1963). Thus. the overall perfor-

[20] *continued*
must produce a result other than the anticipated sum of the separate parts, *E-T Industries, Inc. v. Whittaker Corp.*, 523 F.2d 636, 641 (7th Cir. 1975), *cert. denied*, 429 U.S. 870 (1976); the elements must, in the aggregate, produce new, unusual or striking results, *Panduit Corp. v. Burndy Corp.*, 517 F.2d 535, 539 (7th Cir.), *cert. denied*, 423 U.S. 987 (1975); the results must be unachieved by prior art structures, *Reese v. Elkhart Welding & Boiler Works, Inc.*, 447 F.2d 517, 526 (7th Cir. 1971).

[21] At least in one basic sense, no result is actually greater than the sum of its parts. To the extent that some combination of elements appears synergistic, it is a function of our imperfect knowledge of the properties of the parts. If one could truly get more out of a combination than was put into it, it would amount to a creation of something out of nothing and would contravene the basic laws of nature as we understand them. If these laws remain valid, the appearance of synergism merely indicates prior ignorance instead of creation. Ignorance or lack of knowledge is, however, but part of the question of obviousness. Thus, at best, the appearance of synergism is subsumed within the question of nonobviousness under section 103 and the *Graham* criteria.

[22] Assuming *arguendo* that there exists an exception, the new function should nevertheless not be a *sine qua non* to a finding of patentability, but merely be taken as evidence to be considered along with other evidence available in the obvious-nonobvious inquiry.

mance of the combination is always equal to the sum of the functions of its individual components. As Judge William Conner of the Southern District of New York observed: "In the real world, two plus two never equals five." *Some Highly Personal Reflections on Section 103*, 5 Am. Pat. L.Q. 77, 85 (1977). *Compare Great A & P Tea Co. v. Supermarket Equipment Co.*, 340 U.S. 147, 152 (1950) ("Two and two have been added together and they still make only four.").

A definition of synergism that reflects its etymon is that the elements in the combination must cooperate or interact with each other.[23] So defined, synergism distinguishes those inventions in which the parts are merely aggregated,[24] and those in which the parts coact with each other so that the result comes from the combined effect of the several parts and not simply from the separate action of each. Under this formulation, the presence or absence of synergism, as above defined, proves little. Today, almost all mechanical devices consist of parts which interact with each other. This interaction has little, if anything, to do with the required nonobviousness of the claimed invention. Although the absence of interaction may demonstrate the obviousness of the combination, the presence of interaction assuredly does not impart nonobviousness to a device clearly suggested by the prior art. As thus defined, synergism is simply too broad to provide a useful yardstick with which to measure patentability.

Putting the definitional aspects aside, there are more fundamental flaws in the use of synergism as a standard for patentability. In enacting section 103, Congress expressly mandated nonobviousness, not synergism, as the sole test for the patentability of novel and useful

[23] The term synergism derives from the Greek, *syn*, together, and *ergos*, work, to work together, cooperate. The Oxford English Dictionary (Clarendon Press 1919). *See* Rich, *Laying the Ghost of the "Invention" Requirement*, 1 Am. Pat. L.Q. 26, 43-44 (1972).

[24] The classic example of aggregation is unitary lead pencil and rubber eraser. *See Reckendorfer v. Faber*, 92 U.S. 347 (1876).

inventions: indeed, synergism is not even mentioned in the Patent Act of 1952. Moreover, as section 103 applies to all patent claims, there is no justification why patentability of a combination patent should be measured by a different standard than any other type of invention.

More importantly, when using the synergism approach to determine whether one element functions differently or whether the whole somehow exceeds the parts, one is required to look solely to the operation of the elements *after* they are combined. This analysis suffers from two defects. First, a test which looks exclusively to the functioning of the individual components after they are combined must necessarily be premised on the assumption that it is always obvious to take known elements and combine them. We find this assumption unsound and not based in fact. It may be that in certain circumstances the very choice of the elements to be selected is not obvious. Again, as Judge Hand noted:

> All machines are made up of the same elements; rods, pawls, pitmans, journals, toggles, gears, cams, and the like, all acting their parts as they always do and always must. All compositions are made of the same substances, retaining their fixed chemical properties. But the elements are capable of an infinity of permutations and the selection of that group which proves serviceable to a given need may require a high degree of originality. *It is that act of selection which is the invention* . . . .

B.G. Corp. v. Walter Kidde & Co., 79 F.2d 20, 22 (2d Cir. 1935) (emphasis added). *See also Application of Menough*, 323 F.2d 1011, 1015 (C.C.P.A. 1963).

The second and more basic defect with synergism is that section 103 sets as the standard of patentability the nonobviousness of the invention "at the time the invention was made to a person having ordinary skill in the art . . . ." This provision therefore compels the courts to view the invention from the vantage point of the field of art at a specific point in time, *i.e.*, the time the invention was made. *See* Rich, *Principles of Patentability*, 28 Geo.

Wash. L. Rev. 393, 405-06 (1960). From this vantage point the critical question becomes whether the level of skill in the art was such that the combining of the elements in the manner claimed would have been obvious, not in retrospect, but at the time it was done by the inventor. As the Supreme Court stated in *United States v. Adams*, 383 U.S. 39, 50 (1966), a companion case to *Graham*:

> It begs the questions . . . to state merely that magnesium and cuprous chloride were individually known battery components. If such a combination is novel, the issue is whether bringing them together as taught by [the inventor] was obvious in the light of the prior art.

Synergism, however, precludes this analysis. Because synergism centers exclusively on the performance of the elements *after* combination and without regard to the obviousness or nonobviousness of *making the combination*, synergism does not comport with the *Graham* mandate to apply section 103.

Regrettably, we have heretofore failed to provide clear and consistent guidance regarding the standards appropriate for combination patents. Although we have in fact continued, either explicitly or implicitly, to judge patent validity according to the *Graham* analysis, we have also from time to time commented on the presence or absence of a requirement akin to synergism in the claimed invention under review. And in *St. Regis*, we stated our conclusion in such a way that it may seem that we regard synergism as a test separate from and coequal to that for nonobviousness under section 103. Inasmuch as *Graham* and section 103 continued to be the guiding light, the results of those cases were not in error. But as the foregoing discussion makes evident, this court never intended that synergism be applied literally or that synergism is the *sine qua non* of patentability. Rather, the concept was employed only as a figure of speech to express the truism that when all the parts of a claimed invention are known, the combination (and the act of combining) is likely to be

more obvious to one reasonably skilled in the art.[25] *See Reeves Instrument Corp. v. Beckman Instruments, Inc.*, 444 F.2d 263, 271 (9th Cir.), *cert. denied*, 404 U.S. 951 (1971). However, because synergism has prevented the development of a consistent, predictable body of law under section 103, and because the concept does not bear any logical *ipso facto* relationship to obviousness, the term has little, if any, utility. Therefore until Congress shall otherwise legislate or the Supreme Court shall otherwise specifically hold, this court will continue to apply the *Graham* analysis as the exclusive means by which to measure nonobviousness under section 103.

Perhaps a *caveat* is in order: by our holding today we have no intention of departing from the high standard of patentability which is reflected in the *Black Rock* and *Sakraida* decisions. Though rendered nearly a century ago, the Supreme Court's discussion in *Atlantic Works v. Brady*, 107 U.S. 192, 200 (1883), of the purpose behind the patent laws remains true today:

> The design of the patent laws is to reward those who make some substantial discovery or invention, which adds to our knowledge and makes a step in advance in the useful arts. Such inventors are worthy of all favor. It was never the object of those laws to grant a monopoly for every trifling device, every shadow of a shade of an idea, which would naturally and spontaneously occur to any skilled mechanic or operator in the ordinary progress of manufactures. Such an indiscriminate creation of exclusive privileges tends rather to obstruct than to stimulate invention. It creates a class of speculative schemers who make it their business to watch the advancing wave of improvement, and gather its

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[25] The Supreme Court has expressed this idea in similar terms: "Courts should scrutinize combination patent claims with a care proportioned to the difficulty and improbability of finding [a patentable] invention in an assembly of old elements. . . ." *Great A & P Tea Co. v. Supermarket Corp.*, 340 U.S. 147, 152 (1950). *Accord, Sakraida v. Ag Pro, Inc.*, 425 U.S. 273, 281 (1976).

foam in the form of patented monopolies, which enable them to lay a heavy tax upon the industry of the country, without contributing anything to the real advancement of the arts. It embarrasses the honest pursuit of business with fears and apprehensions of concealed liens and unknown liabilities of lawsuits and vexatious accountings for profits made in good faith.

III

Having thus disposed of the synergism issue, we are left with the question of the instant patent's validity. We begin this analysis by noting that a patent is presumed valid. 35 U.S.C. § 282. That presumption, however, is not conclusive, *St. Regis Paper Co. v. Bemis Co.*, 549 F.2d 833, 838 (7th Cir.), *cert. denied*, 434 U.S. 833 (1977); it merely shifts the burden of proof to the party attacking the validity of the patent. *Maxon Premix Burner Co. v. Eclipse Fuel Engineering Co.*, 471 F.2d 308, 312 (7th Cir. 1972), *cert. denied*, 410 U.S. 929 (1973). Furthermore, that presumption does not exist against evidence of prior art not before the Patent Office. *The Allen Group v. Nu-Star, Inc.*, 575 F.2d 146 (7th Cir. 1978) (per curiam); *Ropat Corp. v. McGraw Edison Co.*, 535 F.2d 378, 383 (7th Cir. 1976). "Even one prior art reference not considered by the Patent Office can suffice to overthrow the presumption." *Henry Manufacturing Co. v. Commercial Filters Corp.*, 489 F.2d 1008, 1013 (7th Cir. 1972). Observing these considerations, we now evaluate the Slaybaugh patent to determine whether it is obvious under the *Graham* criteria.

The parties agree, and the district court found, that the Martin patent, U.S. Patent No. 3,696,462, is pertinent prior art relating to the Slaybaugh invention. The Martin patent, also owned by Republic, describes a hydraulic door closer with multiple-point hold-open but without momentary manual release. The innovative feature of the Martin device was the introduction of an electrically controlled valve in the escape passage of the hydraulic fluid which, when energized by a solenoid,

blocked passage of the fluid, thereby preventing further movement of the piston in the closing direction.[26] Use of the solenoid-operated hold-open valve in this manner had two distinct effects: (1) an open door would close automatically at a controlled rate when the solenoid valve circuit was interrupted, *e.g.*, by triggering of a smoke detector,[27] and (2) the continuing force of the solenoid on the valve made it possible for the door to have a multiple-point hold-open feature. Because of the addition of the valve-solenoid structure, the Martin patent was the first device in the door closer art which had a multiple-point hold-open feature and which could be closed automatically.[28]

The Slaybaugh patent is similar in construction and operation to the Martin device in many respects. Like Martin, Slaybaugh employs a spring and a piston with a cylinder filled with hydraulic fluid. Like Martin, Slaybaugh also uses an electronically operated solenoid hold-open valve apparatus. As a result, it too has the multiple-point hold-open and automatic closing features. The distinctive and, in Republic's view, the innovative feature of the Slaybaugh device is the addition of momentary manual release to the door closer art.

Republic argues that Slaybaugh's contribution to the art—momentary manual release—was achieved by adding components to the Martin patent and by proportioning key elements. The crux of Slaybaugh's improvement over Martin and the principal difference which allows momentary manual release is the employment of a dual area valve. As illustrated in the diagram below, a dual

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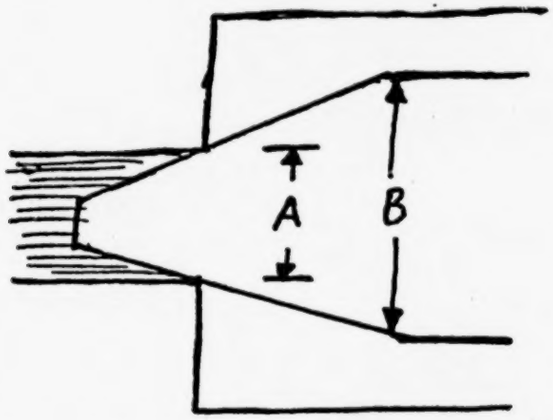
[26] Martin was not the first patent to use a solenoid-operated control valve. Earlier patents, however, used the solenoid to assist fluid pressure in seating the valve rather than to oppose the pressure. *See e.g.*, Rice, U.S. Patent No. 2,394,105; Koch, U.S. Patent No. 1,883,957.

[27] The Martin patent was directed toward satisfying the industry's need for a door hold-open device which could close automatically if fire or smoke were detected.

[28] As with prior door closers, the Martin device could also be closed manually, but the door had to be pushed or pulled continuously all the way toward closure.

area valve is constructed with a face area (B) which is larger than the area of its seat when the valve is closed (A):[29]



Once the valve is opened by the combined force of the closing spring and the momentary push, the fluid pressure acts on a larger face area than it did when the valve was closed. Since force is the product of pressure times area, the high pressure fluid acting on the entire projected valve face area, exposed when the valve is open, develops a force sufficient to overpower the opposing force exerted on the valve by the solenoid. Because the solenoid is overpowered, the valve stays open until the fluid escapes and the door closes by itself, without additional manual assistance.[30]

[29] This diagram is, of course, but a two-dimensional representation of the conical structure in the Slaybaugh device.

[30] The principle of dual area valves is illustrated by the following example: If the area of the valve seat (A) is 0.5 square inch and a force (exerted by solenoid, for example) of 250 pounds is sufficient to keep the valve closed, the valve will crack open when the hydraulic pressure exceeds 500 pounds per square inch (PSI) since 500 PSI times 0.5 square inch equal 250 pounds of force. Once the valve has cracked open, however, the 500 PSI fluid is exposed to the larger area of the

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The Martin patent, however, is not the only pertinent prior art. Other patents, which Republic failed to disclose to the Patent Office, teach the concept of dual area valves.[31] Because Republic did not disclose these, the presumption of validity does not obtain for the Slaybaugh patent against this evidence of prior art. *The Allen Group, Inc. v. Nu-Star, Inc., supra; Ropat Corp. v. McGraw-Edison Co., supra.*[32]

The use and effect of dual area valves in hydraulic systems was described at least as early as 1945 in a publication entitled *Basic Hydraulics.* That article explained the principles of operation involved in a hydraulic pressure relief valve where the area of the valve seat is smaller than the area of the valve face and discussed the effect of this differential area on the valve

[30] *continued*
valve face (B); 1.0 square inch, for example. 500 PSI times 1.00 square inch equal 500 pounds of force then holding the valve open—an amount far in excess of the 250 pound force attempting to close the valve. Accordingly, fluid flows out of the valve seat, past the valve, until the hydraulic pressure drops from 500 PSI to 250 PSI. Until that time the valve remains open, allowing the fluid to escape and thereby closing the door.

[31] *See, e.g.*, Prijatel, et al., U.S. Patent No. 2,980,132; Parker, U.S. Patent No. 2,431,760; Hubbard, U.S. Patent No. 3,117,-321.

[32] Republic argues that Martin, in using a ball valve, also had a dual area valve construction. As a result, Republic contends that the Martin patent is more pertinent prior art than Prijatel, et al., because Martin is in the door holder-closer art. In effect, Republic argues that Martin contains the same dual area valve construction and function that Prijatel, et al. did.

The fact is that most valves do have larger valve face areas than valve seat areas. But such valves, including the ball valve employed by Martin, do not *intentionally* proportion the valve seat area, the valve face area, and the valve biasing force. The Martin patent simply does not teach such a valve intentionally proportioned to open at a predetermined high pressure and then stay open to permit fluid escape until the pressure effect on the valve face drops to a predetermined lower pressure.

operation. *See* note 30 *supra*. It showed that by intentionally proportioning the force of the main spring, the valve seat area, the valve face area, and the amount of force holding the valve closed, one can, by momentarily adding pressure, open a closed valve, then remove that added pressure and yet have the valve remain open.

A number of patents[33] have employed the concepts articulated in *Basic Hydraulics* and have used them to advantage in fluid control relief valves. Although the valves described in these patents vary in their structure and precise mode of operation, each of them teaches use of the differential area concept to keep a valve open at a reduced pressure once it has been opened at a higher pressure. The valves in these patents are constructed in a similar fashion, perform similar functions, and achieve results similar to those achieved by the valve construction defined in claim 8 of the Slaybaugh invention.[34]

Republic argues, however, that these patents are not in the pertinent prior art because they are related to the valve and fluid handling art rather than the door control art.[35] Such a restricted view of the applicable art is not justified. *Cf. Graham v. John Deere Co.*, 383 U.S. 1, 35 (1966); *see also Dann v. Johnson*, 425 U.S. 219, 228-29

[33] *See* note 31 *supra*.

[34] Republic argues that the prior art dual area valves are "dump" valves, while the valve used in the Slaybaugh device is not. Although certain prior art valves were used as dump valves, *see, e.g.*, Hubbard, others were not designed merely to dump all the fluid out of a chamber but rather to keep fluid flowing out of a chamber until the pressure in the chamber dropped below a predetermined level. *See, e.g.*, Prijatel, et al.; Parker.

[35] During the prosecution of the patent, the Patent Office cited several patents for their valve disclosures. *See* patents cited in note 26 *supra*. None of these patents are in the door closer art. Interestingly, Slaybaugh did not argue that these patents were nonanalogous. Rather Slaybaugh argued that the valves were not the same because they did not oppose fluid pressure from downstream of the valve seat and did not have area relationships wherein they would open at a predetermined high pressure and, subsequently, remain open when that pressure dropped to a predetermined lower pressure.

(1976). The prior art that is relevant in evaluating a claim of obviousness is defined by the nature of the problem confronting the would-be inventor. The problem confronting Slaybaugh in developing momentary manual release was to devise a way the door control valve would stay open after it had been manually forced open. Once the problem was recognized, the place to find the solution became apparent. At that point, the art most pertinent to Slaybaugh or any other practitioner in the door closer art was the valve and fluid handling art, not the door control art. Accordingly, the valve art is pertinent to the claimed invention.

Having determined that the differences between Slaybaugh and the pertinent prior art are small does not end our inquiry. "[T]he obviousness test of § 103 is not one which turns on whether an invention is equivalent to some element in the prior art but rather whether the difference between the prior art and subject matter in question is a difference sufficient to render the claimed subject matter unobvious to one skilled in the applicable art." *Dann v. Johnson*, 425 U.S. 219, 228 (1976) (internal quotes omitted). In making that determination, obviousness is measured by what would be obvious to one reasonably skilled in the applicable art, not by what would be obvious to a layman. *Id.* at 229. *See also Graham, supra*, 383 U.S. at 327. And obviousness is measured not by considering what was obvious to actual artisans but by considering whether a hypothetical person, having all of the prior art at hand, would have found the same solution when addressing himself to the same problem. *Popeil Brothers, Inc. v. Schick Electric, Inc.*, 494 F.2d 162, 167 (7th Cir. 1974); *see Systematic Tool & Machine Co. v. Walter Kidde & Co., Inc.*, 555 F.2d 342, 348 n.8 (3d Cir.), *cert. denied*, 434 U.S. 857 (1977); *Malsbary Manufacturing Co. v. Ald, Inc.*, 447 F.2d 809, 813 (7th Cir. 1971), (Stevens, J., dissenting). The district court found, and we agree, that such a hypothetical person in the door closer art would have knowledge of basic hydraulics. This knowledge would have included safety and pressure relief valves which

teach use of the dual area concept to keep a valve open after the initial pressure is reduced.[36]

Even with this awareness, Republic argues that Slaybaugh advanced the art because of his proportioning of the force of the main spring, the valve seat area, the projected valve face area, and the counterforce of the solenoid. This, however, amounted to little more than the mathematical task of filling in the variables of a given equation. We find this proportioning simply to be "the work of a skillful mechanic, not that of the inventor." *Hotchkiss v. Greenwood*, 52 U.S. (11 How.) 248, 267 (1851).

Republic strenuously argues that we should weigh such secondary considerations as commercial success, long felt need, and failure of others. *See Graham, supra*, 383 U.S. at 17-18. Even assuming the presence of these factors in this case—of which we have some doubt—we decline this invitation. While such secondary considerations may be "indicia of obviousness or nonobviousness," *id.* at 18, "those matters 'without invention will not make patentability.'" *Anderson's-Black Rock, Inc. v. Pavement Salvage Co.*, 396 U.S. 57, 61 (1969). Only in a close case, in which application of the primary criteria of nonobviousness under section 103 does not produce a firm conclusion, can these secondary considerations be used to "tip the scales in favor of patentability." *Panduit Corp. v. Burndy Corp.*, 517 F.2d 535, 541 (7th Cir.), *cert. denied*, 423 U.S. 987 (1975). Because we hold that the claims made here are clearly obvious under section 103, we deem it unnecessary to examine these secondary considerations.

The judgment of the district court is affirmed.

A true Copy:

Teste:

Clerk of the United States Court of Appeals for the Seventh Circuit

[36] Slaybaugh himself admitted in a deposition that he was familiar with relief valves of the type disclosed by Prijatel, et al. Defendant's Trial Exhibit No. 38 at 153.

APPENDIX-D

CIRCUIT RULE 35.

The following rule is the Plan for Publication of Opinions of the Seventh Circuit promulgated pursuant to resolution of the Judicial Conference of the United States:

(a) *Policy.* It is the policy of this circuit to reduce the proliferation of published opinions.

(b) *Publication.* The court may dispose of an appeal by an order or by an opinion, which may be signed or per curiam. Orders shall not be published and opinions shall be published.

(1) "Published" or "publication" means:
  (i) Printing the opinion as a slip opinion;
  (ii) Distributing the printed slip opinion to all federal judges within the circuit, legal publishing companies, libraries and other regular subscribers, interested United States attorneys, departments and agencies, and the news media;
  (iii) Permitting publication by legal publishing companies as they see fit; and
  (iv) Unlimited citation as precedent.

(2) Unpublished orders:
  (i) Shall be typewritten and reproduced by copying machine;
  (ii) Shall be distributed only to the circuit judges, counsel for the parties in the case, the lower court judge or agency in the case, and the news media, and shall be available to the public on the same basis as any other pleading in the case;
  (iii) Shall be available for listing periodically in the Federal Reporter showing only title, docket number, date, district or agency appealed from with citation of prior opinion (if reported) and the judgment or operative words of the

order, such as "affirmed," "enforced," "reversed," "reversed and remanded," and so forth;

(iv) Except to support a claim of *res judicata*, collateral estoppel or law of the case, shall not be cited or used as precedent (a) in any federal court within the circuit in any written document or in oral argument or (b) by any such court for any purpose.

(c) *Guidelines for Method of Disposition.*

(1) Published opinions:

Shall be filed in signed or per curiam form in appeals which

(i) Establish a new or change an existing rule of law;

(ii) Involve an issue of continuing public interest;

(iii) Criticize or question existing law;

(iv) Constitute a significant and non-duplicative contribution to legal literature

(A) by a historical review of law;

(B) by describing legislative history; or

(C) by resolving or creating a conflict in the law; or

(v) Reverse a judgment or deny enforcement of an order when the lower court or agency has published an opinion supporting the order.

(2) Unpublished orders:

(i) May be filed after an oral statement of reasons has been given from the bench and may include only, or little more than, the judgment rendered in appeals which

(A) are frivolous or

(B) present no question sufficiently substantial to require explanation of the reasons for the action taken, such as where

(aa) a controlling statute or decision determines the appeal;

(bb) issues are factual only and judgment appealed from is supported by evidence;

(cc) order appealed from is non-appealable or this court lacks jurisdiction or appellant lacks standing to sue; or

(ii) May contain reasons for the judgment but ordinarily not a complete nor necessarily any statement of the facts, in appeals which

(A) are not frivolous but

(B) present arguments concerning the application of recognized rules of law, which are sufficiently substantial to warrant explanation but are not of general interest or importance.

(d) *Disposition is to be by Order or Opinion.*

(1) The determination to dispose of an appeal by unpublished opinion shall be made by a majority of the panel rendering the decision.

(2) The requirement of a majority represents the policy of this circuit. Notwithstanding the right of a single federal judge to make an opinion available for publication, it is expected that a single judge will ordinarily respect and abide by the opinion of the majority in determining whether to publish.

(3) Any person may request by motion that a decision by unpublished order be issued as a published opinion. The request should state the reasons why the publication would be consistent with the guidelines for disposition of appeals as set forth in this rule.

APPENDIX E

* * *

Q. Okay. I hand you some photographs, which we have marked as DDX-89, 90, 91, 92, 93, and ask you if these photographs depict the machine that was built in June, in 1969, in June, 1969?

A. Yes, sir.

Q. Do you know the earliest date on which this machine developed in June, 1969, made any product?

A. The best of my remembrance, we would probably have had some test pieces of samples come up during that same period.

* * *

EXAMINATION BY MR. SIEGFRIED:

Q. Mr. Watts, with respect to Exhibit 98, how can you tell that you had that product ready to sell on the date of September 29, 1969?

A. Well, by having a new product in parenthesis. This to me meant that this was an item that we were setting up on our mill and getting ready to put it on the market and sell it.

Q. Did you have anything to do with setting up the mills?

A. Not a thing, except scheduling as I said earlier.

Q. But you were the shipping foreman at that time?

A. That's right.

Q. Were you not?

A. That's right.

Q. And you controlled the inventory?

A. At that time?

Q. Yes.

A. No, I assisted, but I did not control it.

Q. Well, wouldn't you have had records that showed when you first put a product like DDX-94 into inventory for shipment?

A. The records that we have in front of me is the only thing that I have.

Q. That is the only record that you have?

A. That is the only records I have.

* * *

Q. And what is the date of that calender sheet?

A. This is December.

Q. December of what year?

A. 1969.

Q. And how do you have any reference to a date on that document PDX-150?

A. The week of the 29th.

Q. And what does it say?

A. "Set in double mullion."

Q. And does that also occur on the following day on the 30th of December, 1969?

A. Yes, sir.

Q. If they were setting the double mullion at that time, then they wouldn't have been in production until after it was set, would it?

A. Well, now, it is not—

Q. Isn't that true, it would not have been in production until after the rolls were set?

A. On this particular sheet, that's right.

Q. I am not talking about that particular sheet, I am talking about any particular product?

A. All right. You know, we change those products—we may set this thing six or eight times a year.

Mr. Cook: Let the record show the witness pointed to DDX-94.

A. Now, double mullion or PE-10, ever how you want to determine it, we will set that product, we are running it right now. And three months from now, we will probably set it and run it again. And these notes are just for my record what we were doing on that particular week. Now, that doesn't mean that we didn't set it in September, 1969.

Q. It doesn't mean that you did set it in '69 either, does it, in September?

A. Well, to me, this record says we did.

Q. But you don't know that because you didn't set the rolls, did you?

A. I did not set the rolls.

* * *

Q. So, your notes are incomplete, isn't that correct?

A. I guess so.

Q. Mr. Watts, you don't have any documents to identify the date when any hardened rolls were placed in the machine that is depicted in DDX-89 through 93, do you?

A. No, sir.

Q. And Mr. Watts, you don't have any independent recollection of particular dates in 1969, other than by reference to the documents you have here, is that correct?

Mr. Cook: He didn't say that, now.

Q. I am asking him. All right. I will strike that question. Do you have any recollection without referring to these documents. which are dated 1969, about dates?

A. Well, I know that—

Mr. Cook: Mr. Siegfried, he has already testified about certain dates before he even got to the documentation. So, obviously, all the testimony dealt with independent recollection.

Q. Did you go over these documents, which are PDX-150 and DDX-98, prior to your deposition today?

A. In general, yes.

Q. Did you go over those with Mr. Cook?

A. We mentioned it, and we talked about it.

Q. Did you talk to anybody else about those dates?

A. No.

Q. Isn't it true, Mr. Watts, that you went through a 1968 calender and searched your records for 1968 and you find no reference to any 2 x 2 mullion machine?

A. Yes.

Q. And didn't you also go through your records and notebooks for the year of 1968 and find nothing with respect to the design of a machine to manufacture the 2 x 2 mullion?

A. Yes.

* * *

Q. Do you have any doubt that that document, which you are holding, which is PDX-151, is a copy of a memorandum that came from Vulcan Metal Products?

A. No.

Q. And do you find in that particular document a reference to what is known as PE-10, or the product which is Defendant's Exhibit DDX-94?

A. Yes, sir.

Q. Do you know of any documents of a similar nature to memorandum 294, which would predate the date of February 4, 1970, describing what is known as PE-10 or the DDX-94?

A. No.

* * *

Q. I again ask you, Mr. Ashley, if you know how many feet of product went through what the machine was like, which is shown in Exhibits 89 through 93 before the rolls were hardened?

A. Two pieces approximately 12 foot long.

Q. Isn't it also true then that in order to run that amount of product, the machine would have only operated approximately 30 seconds or less?

A. If we jogged it through, it would operate longer than that.

Q. But if it were going up to speed, it would have been 30 seconds or less?

A. Going up to full speed, it would have been probably, at that time, as slow as we had the machine running a minute or so.

Q. Now, Mr. Ashley, isn't it also true that other sections of the porch enclosure, frame, or other sections of a window frame mullion are also run on that particular mill, which is shown in Exhibits 89 through 93?

A. Yes.

Q. And when were the rolls developed for the other sections I just had reference to?

A. The other sections I cannot say, because they were developed before I came to work with Vulcan Metals.

Q. I am talking, sir, about the machine in front of us here depicted by these photographs, Exhibits 89 through 93. Are you now saying that the rolls that were used in the three machines previously were incorporated in this one rolling mill, which are shown in Exhibits 89 through 93?

A. No, sir, no, sir.

Q. Are you now saying then that there were new rolls or different rolls made so that it would roll the 1 inch stock, or the 1 inch piece like what is shown in DDX-94?

Mr. Cook: Objection. I am not so sure the 1 inch was even made in the machine shown in—

Mr. Siegfried: Counsel, that is exactly what I am trying to establish. I think this witness knows either it was or was not. He has testified it was.

A. Yes. The 1 inch is made on this same mill.

Q. Now, I am trying to establish at this point when the rolls were made to produce that 1 inch piece that would be used on the machine that is shown in Exhibits 89 through 93?

A. It would probably have been December or January of 1970 before we ever put those 1 inch rolls on this machine.

* * *

Q. And when was the first product of the 1 inch style then run in the machine that is the Exhibit 89 through 93?

A. I would say we first set the 1 inch section in there about December, 1969 or maybe January of 1970.

Q. Mr. Ashley, isn't it also true, in order to get a mill ready to produce product that all of the scratches and nicks have to be removed from the unhardened rolls?

A. Not necessarily from the unhardened rolls. We would, after we heat-treat them.

Q. All right. Isn't it also true, then, that in order to heat-treat the rolls, they have to be removed from the machine?

A. Yes.

Q. And can you tell me, sir, when the heat-treated rolls were placed in the machine that is shown in Exhibit 89 through 93?

A. Approximately November of 1969.

Q. And is that your best recollection or are you deducing that from some event or some other thing?

A. That is my best recollection.

Q. You have no documents which would establish that those rolls, which were hardened, were in fact, put in what is shown, the machine shown in Exhibits 89 through 93 in November of 1969, do you?

A. No.

Q. And isn't it also true, Mr. Ashley, that after rolls are hardened, you said they may have to be ground or polished, is that correct?

A. Polished.

Q. And then after they are assembled in the machine, do they also have to be adjusted or reset?

A. Yes.

Q. Mr. Ashley, isn't it true that in looking for documents for preparation for this deposition, and the one that was taken previously by Mr. Carter, you could not find any drawings or sketches on the machine that is depicted in Exhibits 89 through 93, that had any dates on them?

A. That's right, correct.

Q. And isn't it a further fact, that you personally, Mr. Ashley, did not prepare any drawings of the rolls for the machine that is shown in Exhibits 89 through 93?

A. I did not.

Q. Mr. Ashley, during your term of employment with Vulcan Metal Products, have you ever seen a product produced at Vulcan Metal Products, which was sold or to your knowledge to be used as a piece of heat duct?

A. No, sir.

* * *

[R-677,678]

Q. Now, you didn't testify relative to how you would be able to take two Lockformer Machines and somehow put them together to form a piece of duct, did you?

A. No. I didn't say that at all.

Q. Do you think that is possible?

A. It would be very difficult.

* * *

[R-704, 706]

Q. (Continuing)—now, if you were going to form a piece of duct like Plaintiff's Exhibit 25, and use the teachings of Wogerbauer as you described in Figure 25, what type of a depending edge would you have to bend or distort or do something to to get it from the condition that it is in in the front part of Figure 25 to the closing section?

A. The same as you have there (indicating).

Q. And are you telling me, sir, that if you had the two pieces vertically spaced apart, say a foot, and you tried to bring them into the configuration that is shown in Figure 25, that you could do so without first wrinkling the metal and then tearing it?

A. No. I'm not saying that at all.

Q. In other words, you couldn't make this product using the Wogerbauer Technique, could you, Plaintiff's Exhibit 25?

A. Not if you brought it down to a lower welding position.

The only statement that I made was that there are two paths of metal and they are both roll-forming and you can roll-form your heat duct on that machine.

I didn't say you have to break it down and weld it. You have to bring it down and the spacing of the rollers should be in the vicinity of half of the vertical distance of the duct.

Q. Like the plaintiff's machine?

A. Absolutely.

* * *

IN THE

Supreme Court of the United States

OCTOBER TERM, 1978

No. 78-1601

MANUFACTURERS SYSTEMS, INC.,
Petitioner,

vs.

ADM INDUSTRIES, INC., INDIANA TOOL & MFG. CO., INC., DREXELL (REX) L. SIMPSON, AND AMS OF INDIANA, INC.,
Respondents.

PATENT APPENDIX FOR PETITION FOR WRIT OF CERTIORARI TO THE UNITED STATES COURT OF APPEALS FOR THE SEVENTH CIRCUIT

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1979—Northwest Brief Printing Co., 316 Chicago Avenue, Minneapolis 55415—338-5078

PATENT APPENDIX INDEX

United States Patent

Anderson et al.

[15] **3,636,903**

[45] **Jan. 25, 1972**

[54] RECTANGULAR-DUCT FORMING MACHINE

[72] Inventors: **Leroy E. Anderson; Gerald J. Munn,** both of Detroit Lakes, Minn.

[73] Assignee: **Snappy, Inc.,** Detroit Lakes, Minn.

[22] Filed: **Feb. 19, 1970**

[21] Appl. No.: **12,663**

[52] U.S. Cl. ..... **113/54,** 29/200 B, 72/52, 72/181

[51] Int. Cl. **B21d 39/02**

[58] Field of Search ..... 113/54; 72/51, 52, 181; 29/200 B, 463, 429, 208 D

[56] **References Cited**

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3,407,640	10/1968	Lipp	72/181

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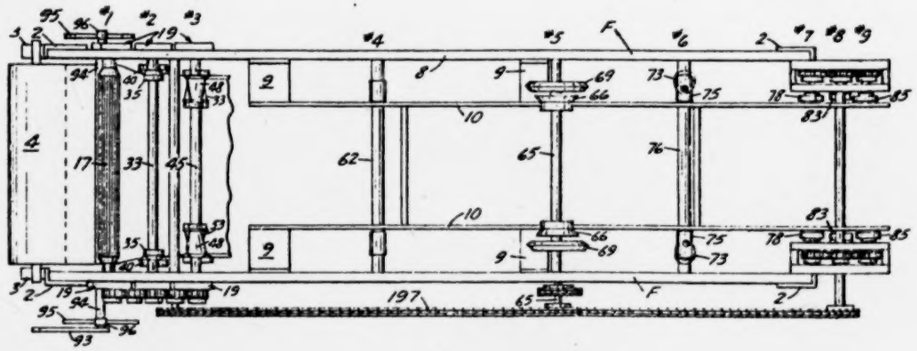
723,908	2/1955	Great Britain	72/52
385,642	11/1923	Germany	113/54

Primary Examiner—Richard J. Herbst
Attorney—Schroeder, Siegfried & Ryan

[57] **ABSTRACT**

A machine designed to continuously progress a pair of elongated flat sheets of metal longitudinally through a plurality of cooperative dies which progressively in sequential steps gradually shape the two sheets into a duct having a rectangular cross-sectional configuration. The machine utilizes cooperative rotary dies to shape and form the duct in a continuous operation to a length equal to that of the sheets so that rectangular ducts of any desired length can be produced in an automatic operation by merely inserting into the machine a preprepared roll comprised of a pair of sheets of metal of the desired length, the sheets entering the machine at one end and leaving the same at the other end in the form of a continuous rectangular duct.

32 Claims, 32 Drawing Figures



PATENTED JAN 25 1972 3,636,903

SHEET 01 OF 10

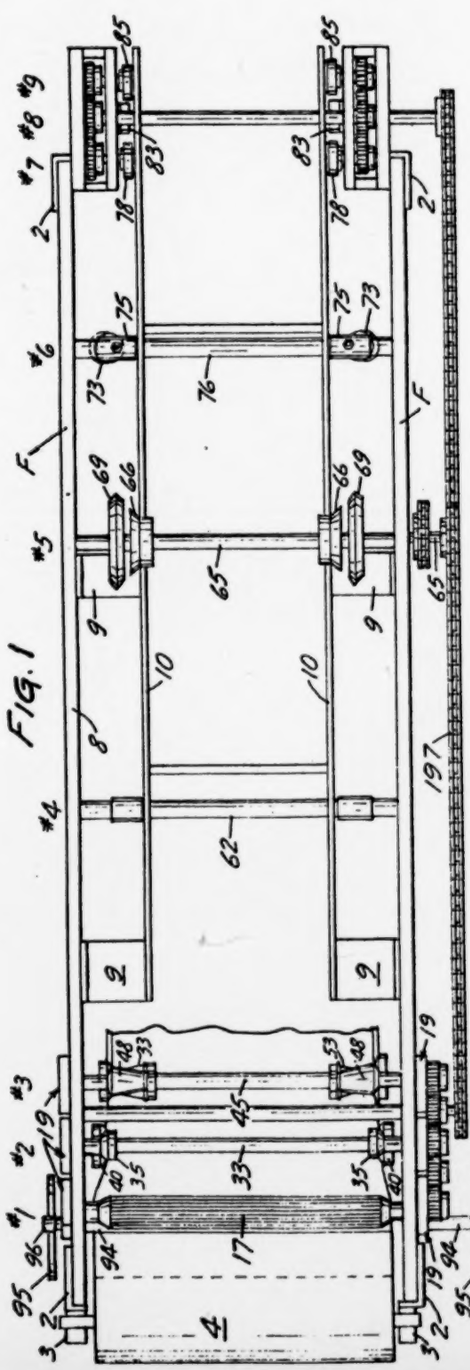


FIG. 1

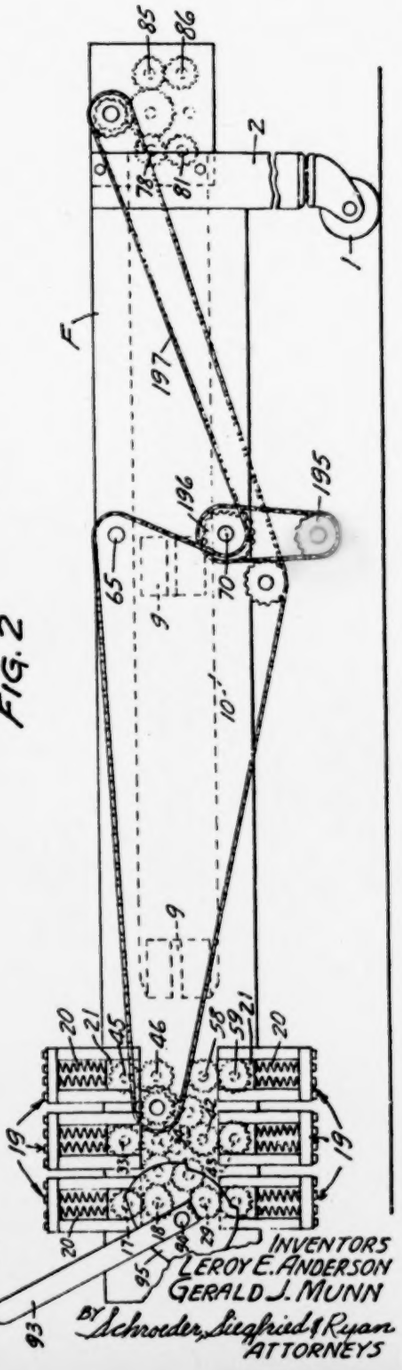


FIG. 2

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ATTORNEYS

PATENTED JAN 25 1972 3,636,903
SHEET 02 OF 10

FIG. 3

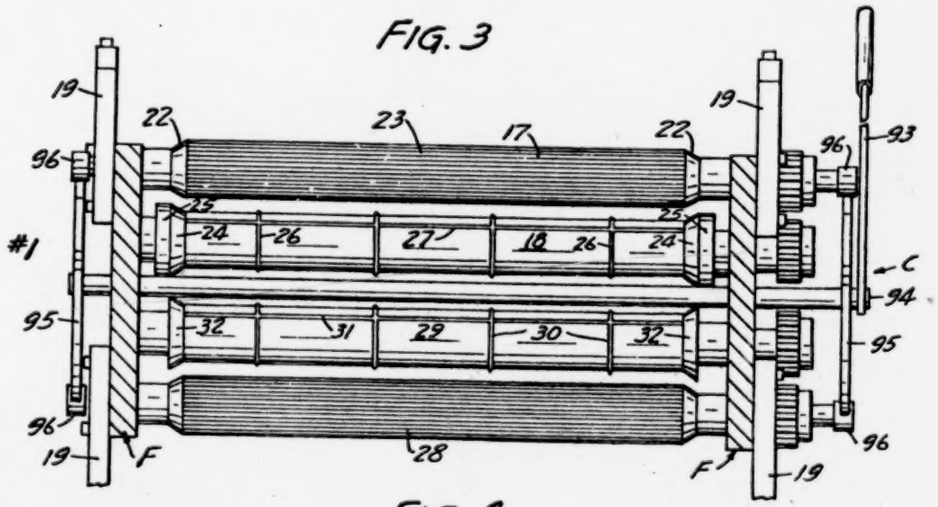


FIG. 4

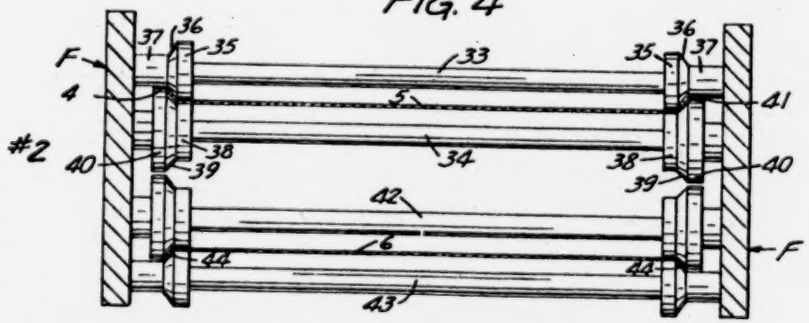
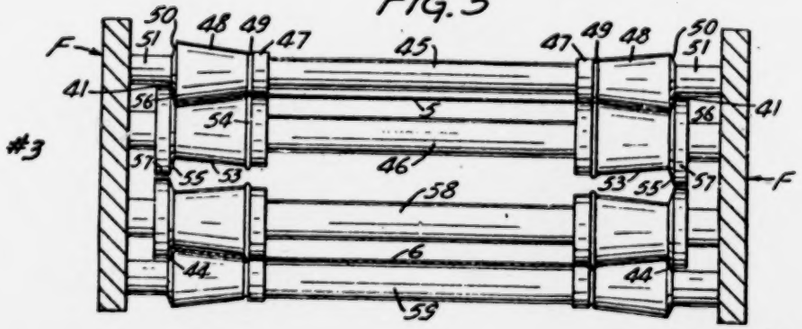


FIG. 5



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PATENTED JAN 25 1972 3,636,903
SHEET 03 OF 10

FIG. 6

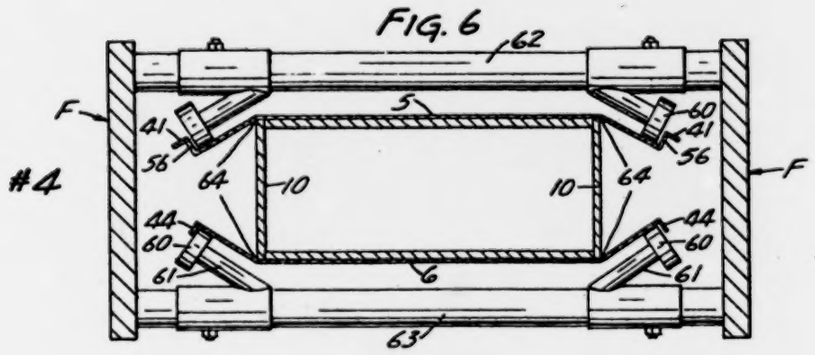


FIG. 7

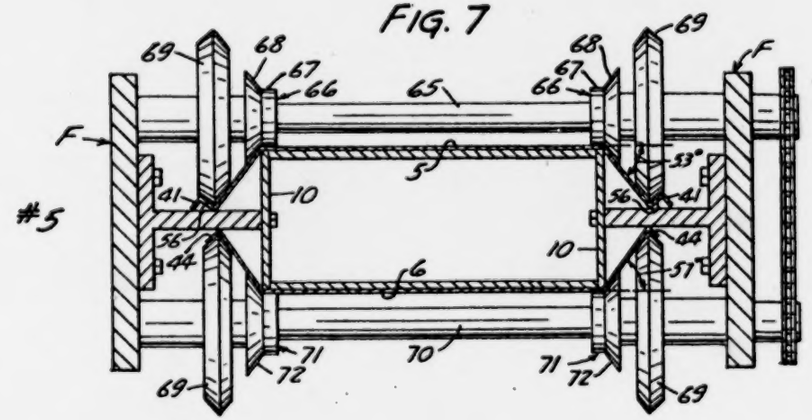
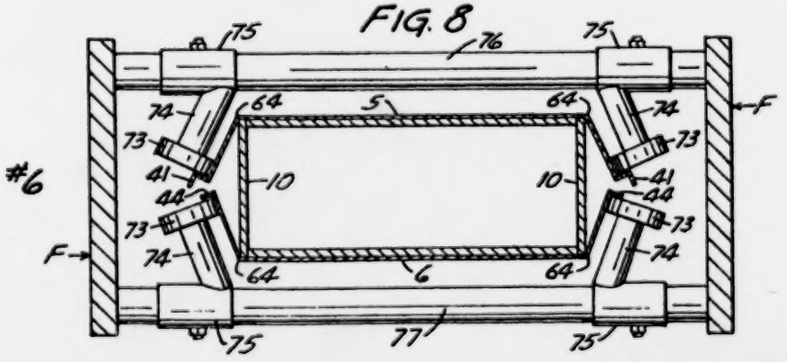


FIG. 8



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PATENTED JAN 25 1972 3,636,903
SHEET 04 OF 10

FIG. 9

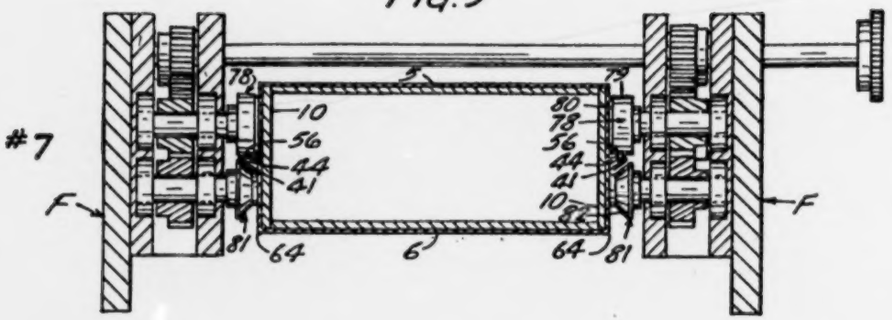


FIG. 10

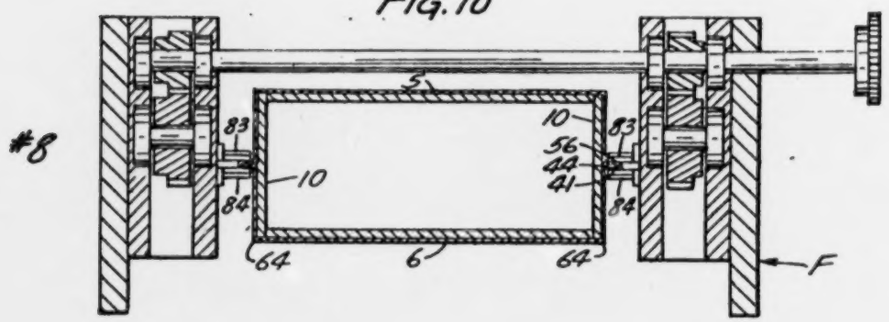
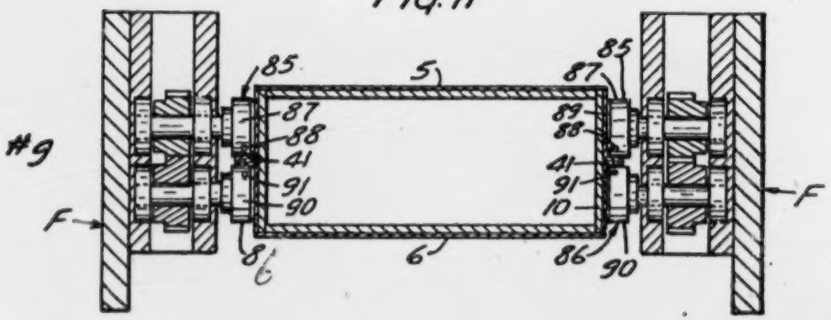


FIG. 11



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PATENTED JAN 25 1972 3,636,903
SHEET 05 OF 10

FIG. 12

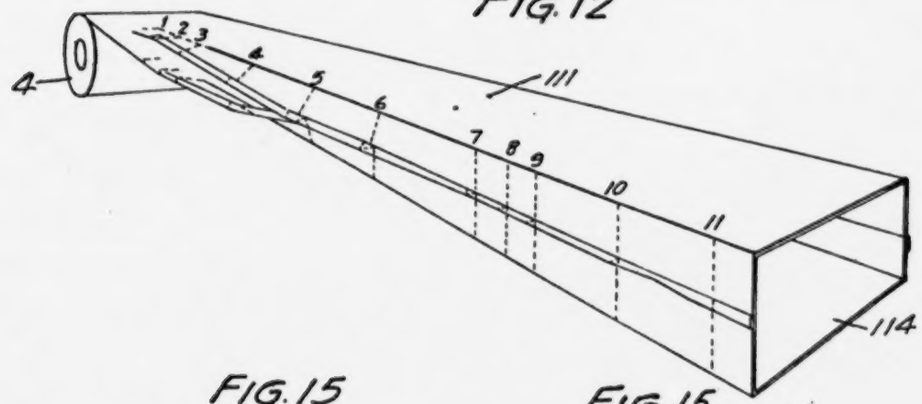


FIG. 15

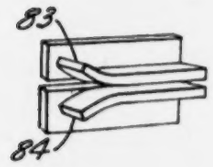


FIG. 15

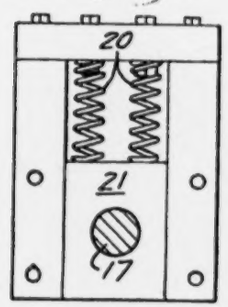


FIG. 13

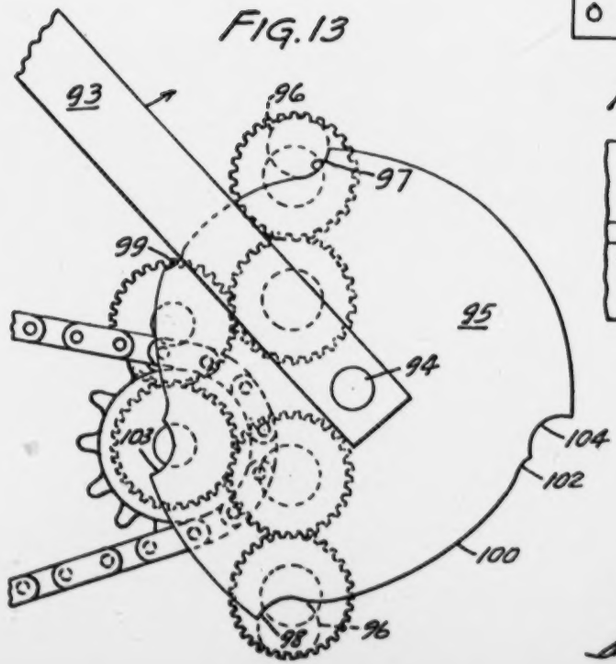
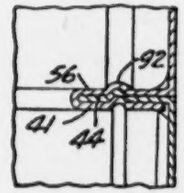


FIG. 16



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PATENTED JAN 25 1972 3,636,903
SHEET 06 OF 10

FIG. 17

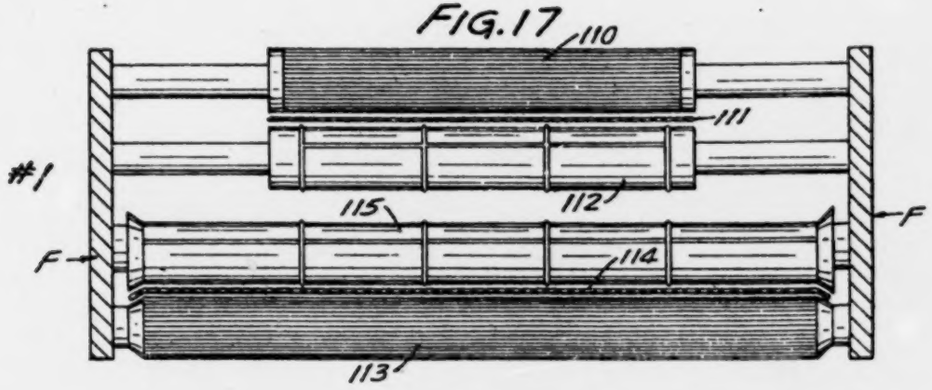


FIG. 18

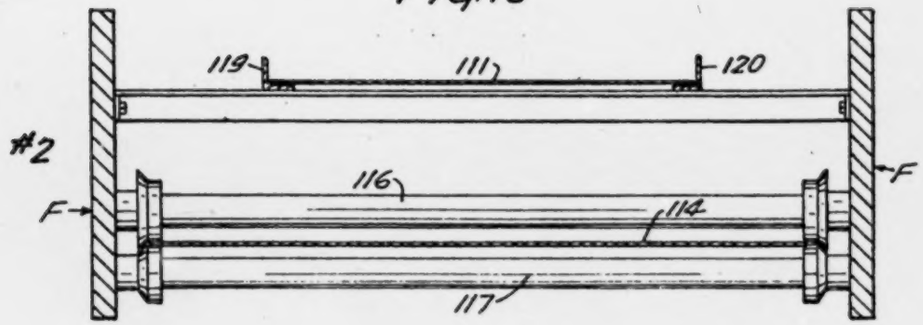
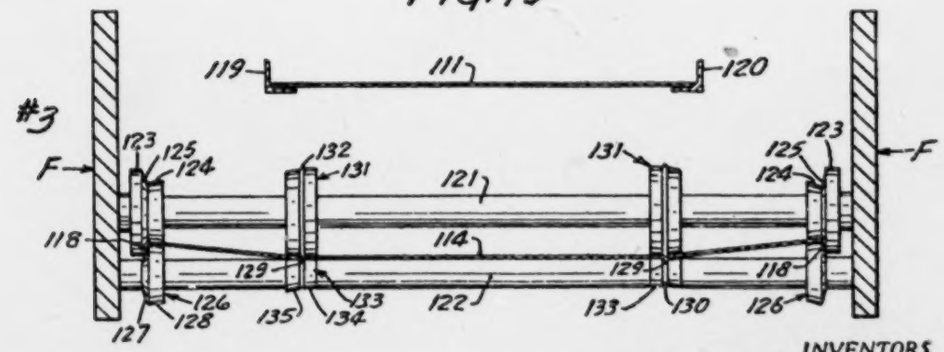


FIG. 19



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PATENTED JAN 25 1972 3,636,903
SHEET 07 OF 10

FIG. 20

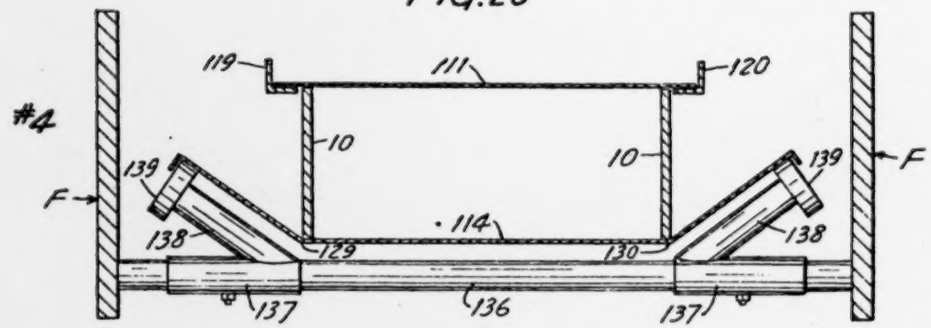


FIG. 21

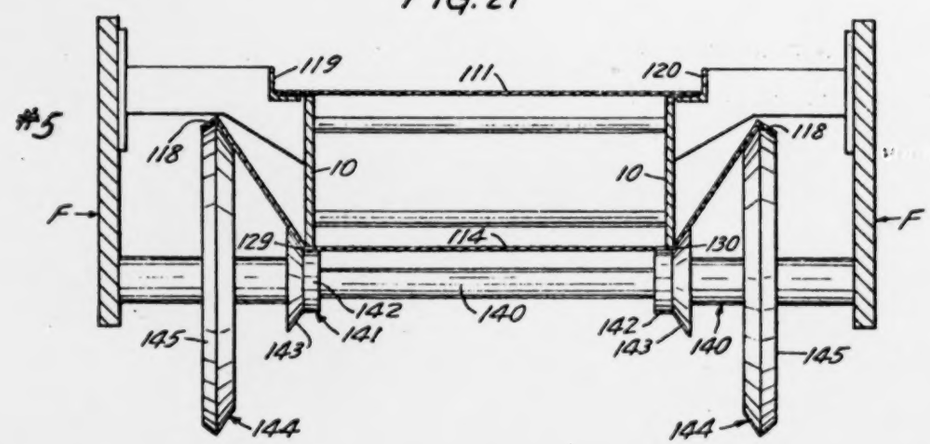
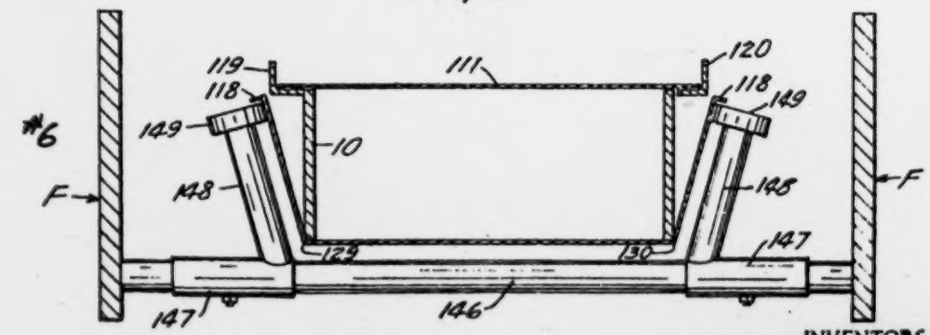


FIG. 22



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PATENTED JAN 25 1972 3,636,903
SHEET 08 OF 10

FIG. 23

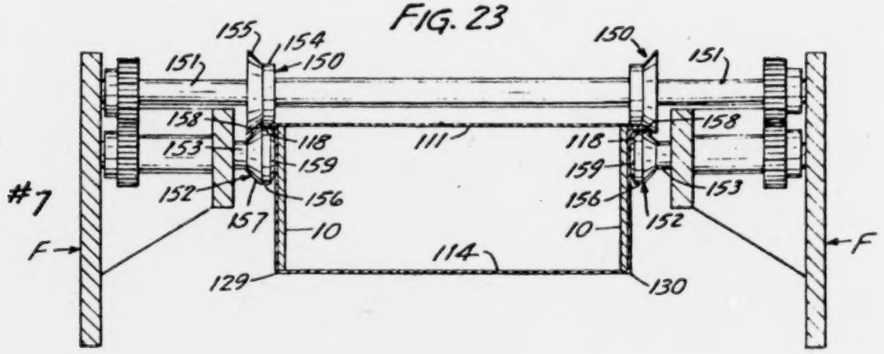


FIG. 24

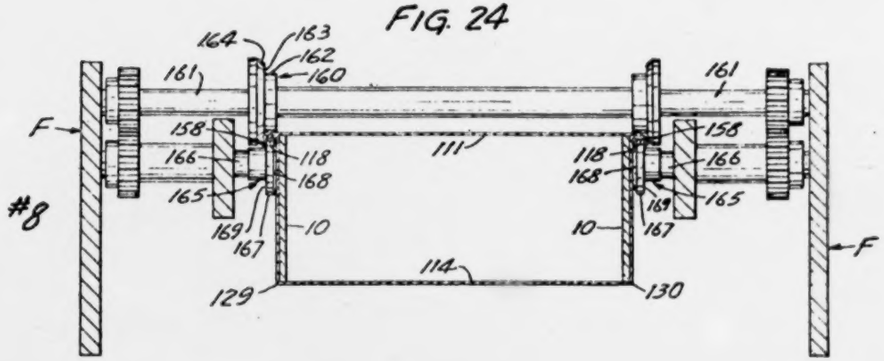
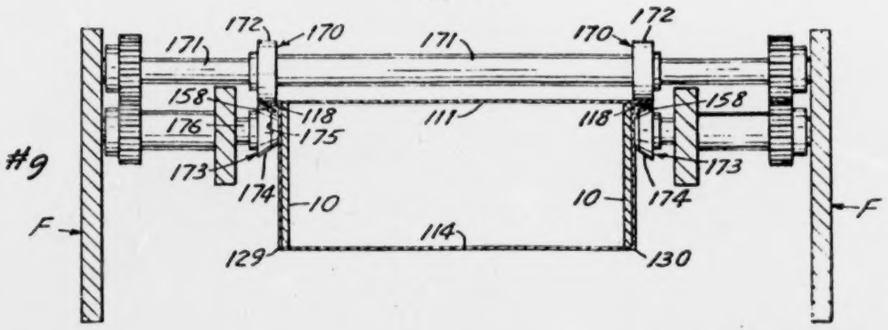


FIG. 25



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PATENTED JAN 25 1972 3,636,903
SHEET 09 OF 10

FIG. 26

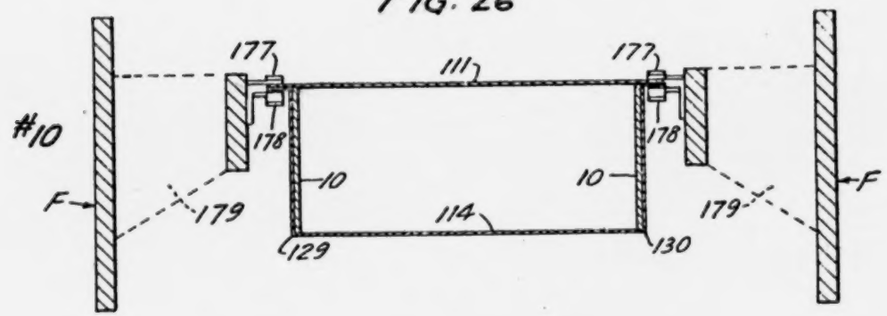


FIG. 27

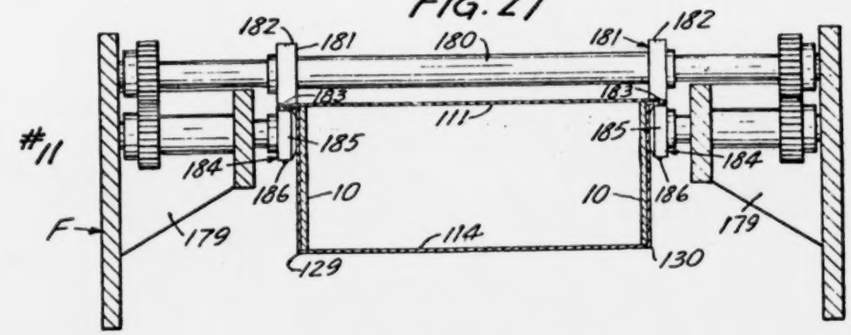


FIG. 28

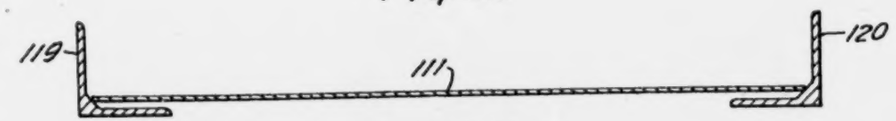
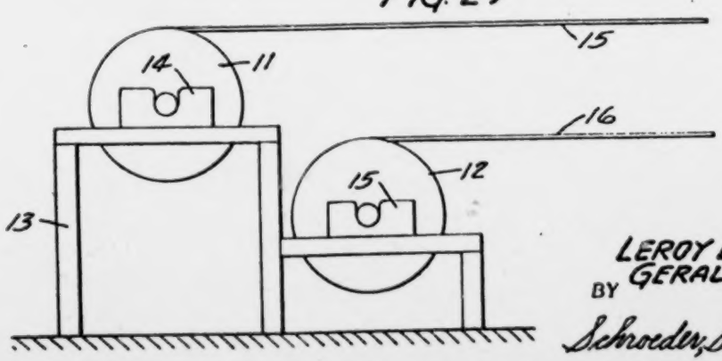


FIG. 29



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PATENTED JAN 25 1972

3,636,903

SHEET 10 OF 10

FIG. 32

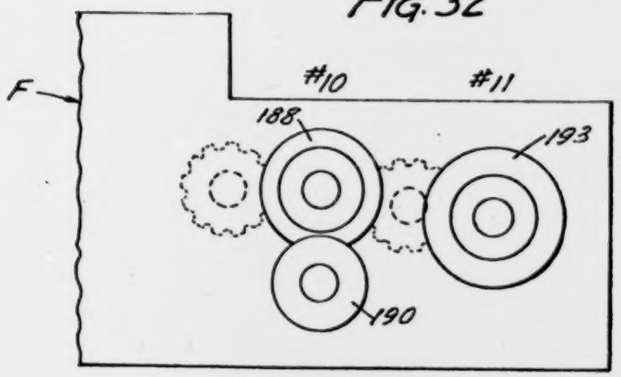


FIG. 30

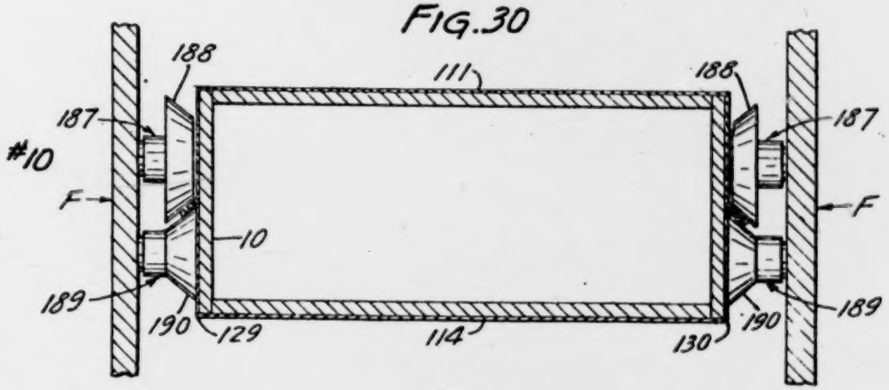
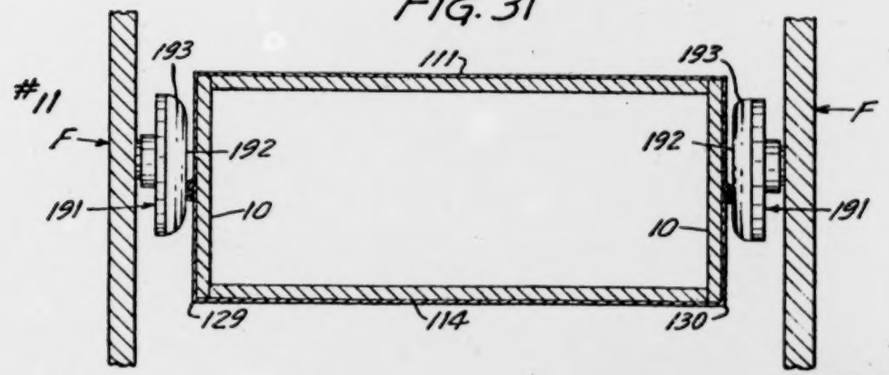


FIG. 31



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RECTANGULAR-DUCT FORMING MACHINE

This invention relates to heating ducts. More particularly, it relates to machines for forming elongated metal ducts having a rectangular cross-sectional configuration.

There is a vast demand today for elongated metal ducts which are generally rectangular in cross-sectional configuration. This is particularly true in the heating industry and especially true with respect to the manufacture of mobile homes. The manufacture of rectangular heating ducts has posed a substantial problem for a long time, particularly where the duct is to be quite extensive in length, as will be realized from the description hereinafter of the method by means of which such ducts have been formed.

The conventional manner of producing rectangular heating ducts has heretofore involved first the selection of a flat sheet of metal of the desired length of the heating duct, provided such length was not too great to make proper handling of the sheet possible. Where relatively long lengths of heating duct were required, such ducts were made in shorter sections and then subsequently secured together. This was particularly true where the ducts had to be transported from the location of manufacture to the location of installation. To manufacture the heating ducts, the flat sheet was formed with a male lock at one edge and a female lock at the opposite side edge, and thereafter the elongated sheet was bent simultaneously throughout its length to impart the rectangular shape and to bring the male and female edges together, preparatory to moving them into mating relation. The final step involved the insertion of the male into the female lock to lock the same to each other. Great difficulty has been experienced in assembling these locks, the main problem being the fact that the male or female edge is frequently bent inadvertently during the efforts involved in shaping the flat sheet into the desired rectangular shape, and as a consequence, great difficulty is experienced in bringing the two edges into proper mating relation. The length of such sections is obviously limited because of these difficulties. Since a duct of any appreciable length must be assembled section by section if it is to be manufactured by the methods heretofore known, a great expenditure of time, effort, and materials is involved in the manufacture of ducts having appreciable length by these methods.

It is a general object of our invention to provide a machine constructed and arranged to continuously form an elongated duct having a rectangular cross-sectional configuration from a pair of flat sheets of metal fed into the machine simultaneously.

A more specific object is to provide a machine constructed and arranged to continuously progress a pair of elongated sheets of flat metal through the machine and automatically form therefrom, in continuous progression, a duct having a rectangular cross-sectional configuration.

A more specific object is to provide a novel machine having a plurality of cooperating rotary dies mounted in spaced relation along the length of a supporting frame and adapted to receive and progressively shape along their length a pair of elongated flat sheets of metal, in sequential steps, into a duct having a rectangular cross-sectional configuration.

Another object is to provide a machine constructed and arranged to receive and continuously progress a pair of elongated flat sheets of metal therethrough, the sheets being formed by and leaving the machine continuously in the form of a duct having a rectangular cross-sectional configuration, the forming of the duct being accomplished through a series of partial progressive bending steps accomplished sequentially through the use of rotary dies at points spaced along the length of the sheets while they are passing through the machine.

Another object is to provide a novel machine constructed and arranged to enable a duct manufacturer to rapidly and efficiently produce elongated ducts of rectangular cross-sectional configuration of any predetermined length by merely feeding into the machine a pair of flat sheets of metal precut to the same predetermined length.

Another object is to provide a novel machine constructed and arranged to manufacture rectangular ducts of any predetermined length at a very substantial saving in time, labor and costs.

Another object is to provide a novel machine constructed and arranged to manufacture rectangular ducts automatically at great saving, the machine itself being compact, automatic in operation, inexpensive to manufacture, trouble-free in operation, and inexpensive and simple to operate and maintain.

Another object is to provide a portable machine which permits users of rectangular ducts such as mobile home manufacturers to manufacture their duct needs in single sections of desired length, whatever they may be, at their operations base, to thereby eliminate the need for transporting preformed tubular sections thereto.

Another object is to provide a novel machine which constructs rectangular tubular ducts from pairs of flat sheets of metal in an automatic operation which produces an end product having improved quality and performance characteristics.

Another object is to provide a machine which automatically constructs rectangular ducts from pairs of flat sheets of metal and which obviates the heretofore need of forming such ducts by bending the material from which the duct is to be made simultaneously throughout its length and which obviates the great difficulties heretofore encountered in assembling the male and female locks utilized in the known conventional manufacturing methods of ducts so shaped.

These and other objects and advantages of our invention will more fully appear from the following description, made in connection with the accompanying drawings, wherein like reference characters refer to the same or similar parts throughout the several views, and in which:

FIG. 1 is a diagrammatic plan view of the preferred form of our invention with stations indicated thereon and without the seam-flattening mechanism being included;

FIG. 2 is a diagrammatic side elevational view of the embodiment shown in FIG. 1;

FIG. 3 is a diagrammatic vertical sectional view taken through station No. 1 of the embodiment shown in FIG. 1;

FIG. 4 is a diagrammatic vertical sectional view taken through the embodiment shown in FIG. 1, at station No. 2, and illustrating how the outermore lateral portions of the two sheets are shaped preliminarily toward becoming cooperative seam elements;

FIG. 5 is a diagrammatic vertical sectional view taken through the embodiment shown in FIG. 1, at station No. 3, and illustrating the manner in which the innermore lateral portions of the two sheets are crimped preliminarily to bending each sheet into oppositely facing channel members and the outermore lateral portions are shaped finally into seam elements;

FIG. 6 is a diagrammatic vertical sectional view taken through the embodiment shown in FIG. 1, at station No. 4, and illustrating the manner in which the lateral portions are guided inwardly at the bead line about the fixed die and into the adjacent and following rotary die members;

FIG. 7 is a diagrammatic vertical sectional view taken through the embodiment shown in FIG. 1, at station No. 5, and illustrating the manner in which the rotary dies cooperate with the fixed die at the bead line and present the outermore lateral portions of the lower sheet toward the corresponding portions of the upper sheet;

FIG. 8 is a diagrammatic vertical sectional view taken through the embodiment of FIG. 1, at station No. 6, and illustrating the manner in which the guide rollers bend the lateral portions of the sheets further inwardly about the bead line and present the lower seam elements to the upper seam elements at an inwardly disposed position to facilitate subsequent interengagement;

FIG. 9 is a diagrammatic vertical sectional view taken through the embodiment shown in FIG. 1, at station No. 7, and illustrating the manner in which the cooperative rotary members complete the bend at the bead lines to 90° and commence closing the same;

FIG. 10 is a diagrammatic vertical sectional view of the embodiment shown in FIG. 1, taken at station No. 8, and illustrating the cooperative camming members closing the seam by camming the overlying seam lip of the upper sheet into parallel and underlying relation to the edge portions of the lower sheet;

FIG. 11 is a diagrammatic vertical sectional view taken through the embodiment shown in FIG. 1, at station No. 9, and illustrating the finishing operation in which the seam is compressed and buttoned to positively lock the seam elements together;

FIG. 12 is a diagrammatic perspective view illustrating how the two flat sheets are taken from a single roll by the embodiment shown in FIG. 1 and progressively formed into a duct having a rectangular cross-sectional configuration, the respective station numbers being indicated thereon at the point at which the two sheets take the shapes indicated thereat;

FIG. 13 is a diagrammatic side elevational view of the controls for the feeding mechanism and initial forming rollers at station No. 1;

FIG. 14 is a diagrammatic side elevational view showing the spring loading provided for the upper set and lower set of rollers of the feeding mechanism and initial forming dies at station No. 1;

FIG. 15 is a diagrammatic detailed perspective view of the seam camming members shown in FIG. 10;

FIG. 16 is a detailed diagrammatic view, shown on an enlarged scale, of the buttoning operation of the rotary dies shown in FIG. 11;

FIG. 17 is a diagrammatic vertical sectional view of a rectangular-duct forming machine constructed similarly to the embodiment shown in FIGS. 1–16, with the exception that its dies are constructed and arranged to form the seams at the corners of the duct rather than at a point intermediate the corners, the view being taken at station No. 1 with the rollers in separated position;

FIG. 18 is a diagrammatic vertical sectional view of the embodiment identified in the description of FIG. 17 and taken at station No. 2 thereof;

FIG. 19 is a diagrammatic vertical sectional view taken at station No. 3 of the embodiment identified in the description of FIG. 17 and illustrating the forming of the 90° lip at the extreme lateral portions of the wider sheet and the initial break at the innermore lateral portions thereof;

FIG. 20 is a diagrammatic vertical sectional view taken at station No. 4 of the embodiment identified in the description of FIG. 17 and illustrating the rollers or helpers which guide the roller sheet from station No. 3 into the succeeding dies of station No. 5 and initiate the bending of the lateral portions upwardly at the break line in cooperation with the fixed die;

FIG. 21 is a diagrammatic vertical sectional view taken at station No. 5 of the embodiment identified in the description of FIG. 17 and illustrating the cooperation between the rotary dies and the fixed dies to bend the lateral portions sharply upwardly;

FIG. 22 is a diagrammatic vertical sectional view taken at station No. 6 of the embodiment identified in the description of FIG. 17 and illustrating the use of the roller guides to further bend the lateral portions upwardly and inwardly to a point adjacent the lateral portions of the upper sheet;

FIG. 23 is a diagrammatic vertical sectional view taken at station No. 7 of the embodiment identified in the description of FIG. 17 and illustrating the cooperation of rotary dies to form the sealing lip at the lateral edge of the upper sheet and the bringing of the lateral portions of the lower sheet to a truly vertical position inwardly of the lip;

FIG. 24 is a diagrammatic vertical sectional view taken at station No. 8 of the embodiment identified in the description of FIG. 17 and illustrating the cooperation of rotary dies to bring the sealing lip to a vertically extending position at the end of the sealing element of the lower sheet and in position to be sealed;

FIG. 25 is a diagrammatic vertical sectional view taken at station No. 9 of the embodiment identified in the description of FIG. 17 and illustrating the cooperation of rotary dies to bring the sealing lip of the upper sheet inwardly and around and below the sealing element of the lower sheet;

FIG. 26 is a diagrammatic vertical sectional view taken at station No. 10 in the embodiment identified in the description of FIG. 17 and illustrating fixed cams which bring the lip into sealing position beneath and against the sealing element at the edge of the lower sheet;

FIG. 27 is a diagrammatic vertical sectional view of the embodiment identified in the description of FIG. 17 and illustrating the manner in which the buttoning dies form the buttons in the seam to lock the sealing elements to each other;

FIG. 28 is a diagrammatic vertical sectional view on an enlarged scale taken through the channel guides which support the upper metal sheet during the formation of the embodiment identified in the description of FIG. 17;

FIG. 29 is a diagrammatic fragmentary side elevational view of a dual cradle mechanism which may be carried by the frame to support two separate rolls of sheet metal in feeding relation to either of the duct-forming mechanisms in lieu of a single composite roll comprised of a pair of such sheets;

FIG. 30 is a diagrammatic vertical sectional view taken through the embodiment of FIG. 1 and showing at station No. 10 structure which may be added to flatten the seam against the sidewall of the duct in the event such is desired;

FIG. 31 is a diagrammatic vertical sectional view taken through station No. 11, which may be added to the combined structure shown in FIG. 1 and FIG. 30, illustrating the final step by means of which the seam is flattened against the sidewall of the duct;

FIG. 32 is a diagrammatic side elevational view showing the means by which the rotary dies illustrated in FIGS. 30 and 31 may be driven by the same drive mechanisms as that shown in FIG. 2.

The preferred embodiment, as shown in FIGS. 1–16, include a movable frame F which is adapted to be moved to a desired location through the use of rollers 1 at the lower end of a plurality of vertically extending supports 2. A cradle 3 rotatably supports a single roll 4 of a pair 5 and 6 of metal sheets. These sheets are arranged in superimposed contiguous relation with each other and rolled into a single roll so that their convolutions are concentric. The upper sheet 5 is slightly wider than the lower sheet 6 and, as can be best seen in FIG. 3, they enter the feeding and initial crimping mechanism, indicated generally by the numeral 7, in vertically spaced relation as they unwind from the roll 4.

The frame F is elongated and has a pair of vertically extending side members 8 which are transversely spaced from each other and carry support brackets 9, which in turn carry elongated transversely spaced fixed inner die members 10. These fixed inner die members 10, as shown in FIGS. 6–9, are comprised of elongated flat metal plates which protrude forwardly beyond the brackets 9 a substantial distance, which can be seen by reference to FIG. 1.

If desired, a pair of separate rolls 11 and 12 (see FIG. 29) of sheet metal may be utilized in lieu of the single composite roll 4. In that event, the rolls 11 and 12 are rotatably supported similarly to the roll 4 upon a composite cradle 13, which utilizes saddles 14 and 15 to rotatably support the shafts on which the rolls are carried. When dual rolls 11 and 12 are utilized, the upper sheet 15 is fed into the machine in vertically spaced relation to the lower sheet 16, as shown.

FIG. 1 shows the preferred embodiment of our duct-forming machine with the various stations to be hereinafter referred to indicated thereon along the length of the machine. It will be noted that station No. 1 is positioned immediately adjacent the roll 4. This station No. 1, which is shown in greater detail in FIG. 3, utilizes a feeding and initial crimping mechanism 7 which includes an upper set of rotary die members 17 and 18, the upper one of which is rotatably mounted so as to be capable of vertical movement relative to the lower

rotary die 18. To permit such movement, each end of the die member 17 is rotatably mounted in a spring loaded bearing structure 19 at each of its ends, the details of which are clearly shown in FIG. 14. Thus, the upper roller 17 is constantly urged downwardly by the action of spring members 20 which press the vertically slidable mounting block 21 and the shaft of the roller 17 downwardly toward engagement with the lower die 18, which is mounted for rotation about a fixed axis upon the frame F.

The upper roller 17 has tapered metal end portions 22 and a major intermediate portion 23, which is formed of a firm but resilient material. The lower metal roller 18 has enlarged end portions characterized by a bevelled surface 24, which is complementary to the bevelled surface 22 of the upper roller 17, and a flat angular surface 25 which extends parallel to and bears against the cylindrical end portion of the roller 17, so that when the two rollers 17 and 18 are brought together these surfaces will function as cooperative rotary dies.

The outer surface of the roller 18 is characterized by a plurality of angular radially outwardly extending circumferential beads 26, which are spaced longitudinally of the roller 18 and a pair of longitudinally and outwardly extending ribs 27. These ribs 27 extend parallel to the axis of the roller 18 and are carried at its circumferential surface and are disposed at opposite sides of the roller.

The lower set of cooperating rotary dies are adapted to receive and progress the lower sheet of metal through the machine and they are the counterpart of the rollers 17 and 18. The lower roller 28 of this set is constructed similarly to the roller 17 and is similarly mounted for rotation and vertical movement in similar movable bearings, except that they are inverted so as to constantly urge the roller 28 upwardly toward the cooperative rotary die 29 which, like the die 18, is mounted for rotation about a fixed axis on the frame F.

The rotary die 29 has angular beads 30 similar to the beads 26 and longitudinally extending ribs 31 similar to the ribs 27. It also has a bevelled surface 32 similar to the surface 24, but, as shown, it has no surface comparable to the angular die surface 25, the relatively narrow lower sheet 6 obviates any need for such surface. The rotary gripping members 17 and 28 are adjustable relative to the rotary die members 18 and 29 through the use of a control system indicated generally by the letter C, which will be described in greater detail hereinafter.

When the two sheets of metal from the roll 4 have been inserted between the members 17, 18 and 28, 29, they will be progressed thereby through the remainder of the machine, since they are each power driven, as will be hereinafter described. The longitudinal ribs 27 and 31 and the angular beads 26 and 30 impart or form ribs on the surface of the flat sheets and provide added rigidity thereto. The cooperative bevelled surfaces 22 and 24 form a 30° bend of the lateral or edge portions of the sheet 5, and the angular surface 25 shapes the extreme edge portions so as to extend parallel to the main body of the sheet, as will be readily appreciated by reference to FIG. 3. This is the initial step in progressively forming the outermore lateral portions of the upper sheet into a sealing element which will ultimately become a portion of the seam. At the same time, the rotary die 29 imparts a bend to the narrower lower sheet 6, at its extreme edge, of a 30° angle, there being no edge portion left extending parallel to the main body of the sheet 6, since the sheet is narrower. Thus the extreme edge portion of the sheet 6 is bent downwardly and away from the sheet 5, just as the lateral portions of the sheet 5 are bent away from the sheet 6.

From station No. 1, the two sheets 5 and 6 move to station No. 2, at which location it enters the second stage of the duct-forming operation. At this location, as shown in FIG. 4, there is positioned a second pair of vertically spaced sets of cooperating rotary dies to impart further shaping of the lateral portions of the sheets 5 and 6, so that the seaming elements will extend at a 60° angle relative to the main body of the sheets. At this station there is located an upper set of rotary dies, identified by the numerals 33 and 34. Each of these dies consist of a shaft rotatably mounted in the frame F and carrying a rotary die member at each of its ends and shaped so as to be complementary and cooperate with the die member of the other. Thus the rotary die 33 has at each of its ends a die member having a flat annular surface 35 and a bevelled 60° surface 26 and an enlarged cylindrical surface 37. The die 34 has at each of its ends a rotary die having an annular surface 38 and a 60° bevelled surface 39 and an enlarged cylindrical surface 40. As clearly shown in FIG. 4, the surface 35 cooperates with the surface 38 and the surface 36 cooperates with the surface 39 to impart a 60° angle to the sealing element, and the surface 37 cooperates with the cylindrical surface 40 to maintain the very edge portion or lip 41 parallel to the main body of the sheet 5.

The lower set of rotary dies, indicated generally by the numerals 42 and 43, are similarly mounted and arranged, the die 42 being constructed identically with the die 34. The lower rotary die 43 is constructed identically with the upper rotary die 33, and they cooperate to impart a 60° angle to the sealing element 44 at the very edge of the lower sheet 6.

From station No. 2, which is shown in FIG. 4, the sheets 5 and 6 are progressed to station No. 3, at which location there is disposed another group of vertically spaced sets of driven rotary dies, mounted for rotation upon the frame F and spaced transversely thereof. As shown in FIG. 5, the upper set is comprised of a pair of cooperating rotary dies identified generally by the numerals 45 and 46. These dies consist of elongated shafts rotatably mounted upon the frame F and carrying at each of its ends a cooperating rotary die member constructed and arranged to impart-additional shaping to the lateral portions of the sheets 5 and 6, preparatory to forming a rectangular duct therefrom. The rotary die 45 has a die member at each of its ends, which has an annular surface 47 separated from an outwardly tapering surface 48 by an annular groove 49. At the larger end of this die is an essentially flat surface 50, which extends essentially normal to the shaft upon which these die members are mounted, and a reduced annular surface 51 is provided outwardly thereof.

The die 46 carries at each of its ends a cooperative rotary die member characterized by an annular surface 52 separated from an outwardly diminishing frustoconical surface 53 by an annular rib 54, which is positioned to extend into the groove 49 as the die members rotate. This die member is further characterized by a surface 55 which extends essentially normal to the shaft of the die 46 and is positioned slightly outwardly of the surface 50 so as to cooperate therewith to impart a 90° angle to the seam element 56. It is further characterized by an enlarged annular surface 57, which cooperates with the cylindrical surface 51 to cause the lip 41 to extend essentially normally to the sealing element 56.

The lower set of rotary dies, identified by the numerals 58 and 59, are similarly constructed and arranged to shape the lower sheet 6. The rotary die 58 is constructed identically with the rotary die 46, and the rotary die 59 is constructed identically to the rotary die 45, and they cooperate in a similar manner to impart the same shape to the lateral portions of the sheet 6, except, of course, that the extreme edge portion, or sealing element 44, carries no lip element corresponding to the lip element 41 because of its narrower width.

From station No. 3, which is shown in FIG. 5, the sheets move to station No. 4, at which they encounter the structure shown in FIG. 6. At station No. 4 the sheets reach a helper station at which they are guided inwardly by a plurality of rotatably mounted rollers 60, each of which is carried by a spindle or shaft 61 and is supported upon one of transverse members 62 or 63 as shown in FIG. 6. It is at this station that the sheets 5 and 6 first encounter the fixed die member 10, which are positioned so as to be disposed just inwardly of the break lines 64, which were imparted to the two sheets by the cooperative action of the annular ribs 54 and grooves 49 at station No. 3, as shown in FIG. 5. It will be noted that the rollers 60 are positioned so as to engage the lateral portions of the sheets 5 and 6 just inwardly of the sealing element. These

rollers 60 are not driven, but are free to rotate on the shaft 61, which in turn are adjustably mounted on the transverse members 62 and 63 through the use of sleeves as shown. These rollers 60 guide the lateral portions of the sheets 5 and 6 inwardly toward each other so as to progressively break the sheets at the break line 64 and guide them into the rotary dies at station No. 5, which are shown in FIG. 7.

FIG. 7 shows a plurality of driven rotary dies cooperating with the fixed dies 10. A power-driven upper shaft 65 is rotatably mounted upon the frame F to extend transversely thereof and carries at each of its end portions a rotary die member 66 having a cylindrical surface 67 and a 53° outwardly bevelled surface 68. Each of these rotary die members 66 are positioned so that the cylindrical surface 67 bears upon the upper sheet 5 just inwardly of outer surface of the fixed die member 10 and the bevelled surface is disposed just outwardly thereof so as to bring the lateral portions of the sheet member 5 inwardly 53° from the plane of the sheet. The shaft 65 also carries at each end a disk-shaped guiding member 69, which rotates with the shaft and extends into the angle formed by the sealing element 56 so as to guide the outermore lateral portions of the sheet inwardly toward the sheet 6, as shown in FIG. 7.

A lower and similarly mounted shaft 70 carried identically constructed guide members 69 and a pair of rotary die members 71, which are constructed and positioned similar to the rotary die member 66, except that the angle of the bevel 72 is such as to impart a 57° angle to the lateral portions of the sheet 6 and thus move the sealing element 44 inwardly at each side to an extent farther and ahead of the sealing element 56 of the sheet 5. This arrangement is utilized in order to insure that upon further movement of the lateral portions of the two sheets inwardly the sealing elements will mate properly.

From station No. 5, as shown in FIG. 7, the sheets 5 and 6 move onwardly to station No. 6, which is shown in FIG. 8. Here again, the sheets encounter a helper station in the form of rollers 73, each of which is rotatably mounted for free rotation about a spindle 74 that is carried by a sleeve 75 upon a transverse member such as 76 or 77. These rollers 73 guide the lateral portions of the sheets 5 and 6 further inwardly as they bend further at the break lines 64. It will be noted that the rollers 73, which are carried by the lower transverse member 77, are positioned inwardly slightly farther than those carried by the upper member 76 so that the sealing element 44 is disposed somewhat inwardly of the sealing element 56 and the lip 41 at each side of the machine. Note that the two sheets 5 and 6 have been gradually and progressively formed in sequential steps into two oppositely facing channel members which are essentially U-shaped in cross-sectional configuration. As these sheets continue to progress through the machine, even further bending takes place until a truly rectangular configuration is obtained. The effect of the rollers 73 is felt by the material of the sheets 5 and 6 which is disposed thereahead so that the sheets are properly guided into the mechanism at station No. 7, which is shown in FIG. 9.

At station No. 7 there is provided a plurality of rotary die members constructed and arranged to close the rectangular configuration and commence to close the lip 41 around the sealing elements 44 so as to hold the latter between it and the sealing element 56. Carried by the frame F at opposite sides of the fixed dies 10 and cooperating therewith is a pair of rotary die members which are identical in construction and identified generally by the numeral 78. Each of these rotary die members 78 has a cylindrical compressing surface 79 and a slightly bevelled inner end surface 80. The latter gradually bends the lateral portions of the sheet 5 inwardly to a 90° angle against the fixed die and at the same time the cylindrical surface 79 brings the sealing element 56 and the lip 41 downwardly and around the relatively inwardly disposed sealing element 44. A pair of rotary die members indicated generally by the numeral 81 is also carried by the frame F in position to cooperate with the rollers 78 and toward that end they are constructed to provide a bevelled camming surface 82, which engages the lip 41 and brings it inwardly to an angulated position relative to the sealing element 56 and somewhat around and below the sealing element 44 of the sheet 6. Thus the construction shown completes the 90° bend at the side of the duct and commences the closing of the seam member which ultimately consists of the two sealing elements 44 and 56 held in sealed position by the sealing element 41, as will be hereinafter described. It will be noted that the two rotary die members 81 are positioned at opposite sides of the fixed die members 10 and have similar bevelled inner ends which complete the 90° bend of the sheet 6 at the break line 64 in addition to commencing the closing of the seam.

From position 7 as shown in FIG. 9, the sheets 5 and 6 move to station No. 8, at which they encounter the structure shown in FIG. 10. At this station there is provided at each of the sides of the now rectangular configuration additional camming structure constructed and arranged to complete the formation of the seam. As shown in FIG. 10, mounted upon the frame F outwardly of the fixed dies 5, and in position to receive therein the seam elements 44 and 56 and the lip 41, is a pair of camming members 83 and 84. These camming members 83 and 84 are fixed and vertically spaced from each other a distance essentially equal to the combined thickness of the elements 41, 44, and 56. The end portions of the camming members 83 and 84 which face toward the direction from which the sheets 5 and 6 move are somewhat flared as shown in the detailed view of FIG. 14 to facilitate entrance of these elements thereinto. As the sheets 5 and 6 are drawn past station No. 8, the seam which is now comprised of the seam elements 44 and 56 and the lip 41 is completed, the lip 41 being brought into flattened position around and below the sealing element 44 of the lower sheet 6. Elements 83 and 84 are provided at each side of the duct so that as the sheets pass thereby the seam is completed to the configuration shown in FIG. 10.

As the now rectangular configuration comprised of the sheets 5 and 6 leave station No. 8 as shown in FIG. 10, it proceeds to station No. 9, which is shown in FIG. 11. At this station the seam at each side of the duct, which consists of the elements 41, 44, and 56 in flattened condition, passes through one of a pair of vertically spaced rotary die members 85 and 86, one each of which is disposed at each side of the duct. Each of the rotary die members 85 is characterized by a cylindrical surface 87, which bears against the outer surface of the sealing element 56 and a pair of recesses 88 which are oppositely disposed within said cylindrical surface. A bevelled end surface 89 is also provided to facilitate movement of the rectangular duct thereby. Each of the rotary die members 86 is characterized by a cylindrical surface 90 which bears against the underside of the sealing lip 41 and compresses the latter to flatten the seam and compress it. Each rotary die member has a pair of outwardly extending buttons 91 which are positioned so as to pass directly opposite the recesses 88 as they rotate, and thus impart a locking button 92 at spaced locations approximately 3 inches apart along the seam to the metal of the elements 41, 44, and 56, which make up the seam. This button 92 positively locks the elements which make up the seam to each other and precludes separation during subsequent handling of the duct. An enlarged detailed view of the button being formed is shown in FIG. 15.

FIG. 12 shows a diagrammatic perspective view which illustrates the manner in which the individual sheets of the roll 4 gradually move therefrom through the machine and assume in sequential steps the shape which is illustrated at the locations identified thereon by numerals corresponding to the stations hereinbefore described. Thus it can be seen that the two flat sheets of metal 5 and 6 are progressively converted from flat sheets into a duct having a rectangular cross-sectional configuration as these sheets are drawn through the machine, the duct entering the machine at one end in the form of two sheets and being discharged from the opposite end in the form of a continuous rectangular duct which can be constructed of any desired predetermined length merely by providing a roll having two such sheets 5 and 6 of such desired length.

The feeding and initial crimping mechanism shown in FIG. 3 and identified by the letter C is controlled through a handle member 93 which is fixedly connected to rotate with a transverse shaft 94 which is rotatably mounted and extends through the frame F. At each end of the shaft 94 there is a cam member 95, the details of which are shown in FIG. 13. These cams 95 are fixed to the shaft 94 and rotate therewith, and they have an irregular camming surface designed to control the relative movement of the members 17 and 28 toward and away from the rotary die members 18 and 29. This is accomplished through the use of rollers or cam followers 96, which are carried at each end of the members 17 and 28. Reference to FIG. 13 will disclose the irregular camming surface of the cams 95.

The lever 93 and cam 95 are positioned in FIG. 13 so as to present the camming surfaces having the maximum radius to the cam followers 96. This position is identified as position No. 1 and, since the camming surfaces 97 and 98 having the largest radius engage the cam followers 96 in this position, the upper roll 17 and the lower roll 28 will be positioned in open position and in nonengaging relation to the rolls 18 and 29. While in this position the forward end of the lower sheet of metal 6 is inserted between the rolls 28 and 29 and the lever member 93 and the cams 95 are rotated about the shaft 94 to position No. 2, which is at the camming surfaces identified by the numerals 99 and 100. It will be noted that the distance from the center of shaft 94 to the camming surface 99 is essentially equal to the distance between that shaft and the camming surface 97 at position No. 1 and hence the upper roll 17 will remain in open position. On the other hand, the distance from the center of shaft 94 to the camming surface 100 is substantially less than that between that shaft and the camming surface 98 at position No. 1 and hence the roll 28 will be moved by the springs 20 into engagement of the forward end of the lower sheet 6 to grip the same in cooperation with the roll 29.

Once the sheet 6 has been gripped between the rolls 28 and 29, the lever 93 and cams 95 may be rotated further until the camming surfaces identified by the numerals 101, 102 bear against the cam followers 96. This is known as the rest position in which the rolls 28 and 29 are closed and the rolls 17 and 18 are also closed. This is true because it will be seen that the distance from shaft 94 to camming surface 102 has been reduced sufficiently so that roll 17 is permitted to lower and grip the forward end of the upper sheet which is extended therebetween manually just prior to movement of the lever to rest position, or position No. 3. Further movement of the lever 93 sufficient to cause the camming surfaces identified by the numerals 103 and 104 to engage the cam followers 96 (position No. 4) leaves the rolls 17 and 18 and 28 and 29 in position holding the sheets 5 and 6 in the same manner as in position No. 3, but also closes an electrical switch which causes the driving motor of the machine to be activated and rotate the rolls 17, 18, 28 and 29 to cause the sheets 5 and 6 to be progressed through the machine.

In the event a flattened seam is desired, the frame F may be constructed of sufficient length to also carry the mechanisms shown in FIGS. 30–32, which will be described hereinafter. Description of the structure will be made hereinafter subsequent to the description of the structures shown in FIGS. 17–29 inclusive.

FIGS. 17–29 illustrate a similar machine to that shown in FIGS. 1–16, except that the dies are constructed and arranged to form the seams at the corners of the rectangular duct rather than at the intermediate portions of the sides of the duct. The same cradles may be utilized as desired, but the roll of metal will be comprised of sheets of different widths as is shown in FIGS. 17–28. The same type of feeding and initial crimping mechanism may be utilized except that the rolls will be constructed differently. Thus in FIG. 17, station No. 1 is shown wherein the vertically movable roll 110 is substantially shorter so as to conform to the narrower widths of the upper metal sheet 111. The roll 110 is provided with a resilient intermediate portion and metal end portions comparable to the construction of the roll 17. The cooperating roll 112 is constructed similarly to the roll 18, except that it, too, is shorter to conform to the narrower width of the upper sheet 111. The lowest roll 113 is constructed similarly to roll 28, but it is longer in length to conform to the substantially greater width of the lower sheet 114. The upper of the lower set of rolls 115 is constructed in the same manner as roll 29, except that it, too, has a substantially greater length to conform to the greater width of lower sheet 114. The rolls 110, 112, 113, and 115 form the same functions of gripping and moving the sheets forwardly as do the rolls shown in FIG. 3. The rolls 113 and 115 form a 30° angle of the edge portion of the sheet 114 in the same manner as the rolls 28 and 29 function. Since the rolls 110 and 112, however, do not have a bevelled end portion 22, the only effect these rolls have upon the upper sheet 111 is to impart the transverse and longitudinal ribs to the sheets to provided added rigidity in the same manner that the beads 26 and ribs 27 function upon the sheet 5.

FIG. 18 shows station No. 2 of the modified form of the invention. As the sheets pass through station No. 1, as shown in FIG. 17, they enter the structure shown in FIG. 18 for further modification corresponding to that which takes place in station No. 2 of the preferred embodiment. Thus, the rolls 116 and 117 correspond to rolls 42 and 43, and similarly impart a 60° angulation to the seal element 118 at each of the lateral edges of the sheet 114. The sheet 111 enters a pair of guiding channels 119 and 120 which are supported by the frame F and extend longitudinally thereof at the central position shown. No modification of sheet 111 takes place at station No. 2, and the only modification to sheet 114 is to impart a 60° angulation to the sealing element 118 and progress the sheet forwardly to station No. 3, which is shown in FIG. 19.

At station No. 3, the upper sheet 111 continues to ride within the channel members 119 and 120, and no modification thereof is accomplished at this station. The frame F carries at this station, however, a pair of transverse shafts 121 and 122 which are power driven and carry cooperative rotary die members. At each end of the shaft 121 there is a rotary die having a cylindrical surface 123 which is reduced to a bevelled surface 124 and tapers gradually thereto as at 125. Each of these rotary die members cooperate with another rotary die member such as 126 that is carried by the lower shaft 122. These rotary dies 126 have a somewhat bevelled end surface 127 which cooperate with the bevelled surface 125 to move the sealing element 118 to extend normal to the immediately adjacent lateral portion of the sheet 114. The surfaces 124 and 128 cooperate to hold the material immediately adjacent the sealing element 118 firmly.

Disposed inwardly of the rotary dies carried at the ends of the shafts 121 and 122 are two pairs of cooperating dies which provide the initial break to the sheet 114 at break lines 129 and 130 which eventually become the corners of the duct. The shaft 121 carries a pair of identical rotary dies 131, each of which is characterized by an annular centrally disposed rib 132, and the adjacent surfaces of which slope away therefrom to a diminished radius, as clearly shown in FIG. 19. Cooperating with each of these dies 131 and carried by the shaft 122 in position to form the break lines 129 and 130 is a pair of rotary dies indicated by the numeral 133. Each of these dies is characterized by an annular groove 134, which is centrally located intermediate the ends of the die and by an adjacent tapering surface which increases in radius from the groove toward the outer end of the shaft and is indicated by the numeral 135. As shown, these rotary dies cooperate to provide the initial shaping of the sheet 114 toward a U-shaped construction adapted to be closed eventually by the sheet 111.

As the sheets 111 and 114 leave station No. 3, they proceed toward station No. 4, which is shown in FIG. 20. Here again the upper sheet 111 continues to be carried by the channel members 119 and 120 without modification thereto. It will be noted, however, that the fixed die members 10 are now disposed above the lower sheet 114 just inwardly of the break

lines 129 and 130. At this station there is provided a transverse shaft 136 which rotatably mounts by means of sleeves 137 and spindles 138, a pair of guiding rollers 139 which rotate freely on the spindles. These rollers 139 provide a function comparable to that provided by the rollers 60 in station No. 4 of the first embodiment and, as will be seen by reference to FIG. 20, bring the lateral portion of the sheet 114 upwardly and inwardly and guide the same into the dies at station No. 5, which is shown in FIG. 21.

At station No. 5 in FIG. 21, the upper sheet 111 is still carried in the channel members 119 and 120 and remains unmodified. The frame F carries a transverse shaft 140 which rotatably mounts a pair of rotary dies such as indicated by the numeral 141. Each of these dies has an annular surface 142 and an outwardly bevelled surface 143 and is positioned so that the latter surface engages the lateral portions of the sheet 114 and bends them upwardly approximately 57° off the plane of the sheet 114. It will be noted that each is positioned so that the annular surface 142 is disposed immediately below the fixed die members 10 and the bevelled surfaces 143 commence at the outer surface of these fixed die members. Also carried by the driven shaft 140 and disposed outwardly of the rotary dies 141 is a pair of guiding disks or rollers indicated generally by the numeral 144. These guiding rollers are bevelled to come to an edge intermediate their axial ends and are shaped so as to engage and complement the edge portion of the sheet 114, the edge 145 of each of these rollers extending into the angle formed by the sealing element 118.

As the sheets leave station No. 5 which is shown in FIG. 21, they move to station No. 6 which is shown in FIG. 22. At this station the upper sheet 111 still remains unmodified and is carried by the channel members 119 and 120. A transversely extending shaft 146 is carried by the frame F and mounts by means of a sleeve 147 and a spindle 148, a freely rotatable roller 149 at each of the outer sides of the fixed die 10. The spindles 148 extend upwardly and slightly outwardly and position the rollers 149 so as to bring the lateral portions of the sheet 114 inwardly toward the fixed die members 110. These guide rollers 149 bring the lateral portions to extend approximately 75° from the plane of the sheet 114 and guide the sheet into the mechanism of station No. 7, which is shown in FIG. 23.

The channel members 119 and 120 terminate between stations No. 6 and No. 7 and at station No. 7 sheet 111 is acted upon by a pair of rotary dies indicated generally by the numeral 150. This pair of rotary dies 150 is mounted upon a powered transverse shaft 151, which is carried by the frame F. Each of the rotary die members 150 cooperates with another rotary die member indicated generally by the numeral 152, which is positioned immediately therebelow and supported upon a shaft 153 which likewise is powered and supported by the frame F. Each of the rotary dies 150 has an annular die surface 154 which terminates just short of the lateral edge of the sheet 111 and merges with an outwardly flaring die surface 155, as shown in FIG. 23. The lower dies 152 have an annular surface 156 which cooperates with the annular surface 154 and merges into a diminishing die surface 157 which cooperates with the flaring die surface 155 to form the outer edge portion of the sheet 111 into an angulated lip 158. It will be noted that the break lines 129 and 130 are spaced a distance less than the width of the sheet 111 so that the lip 158 is formed opposite the outer end of the sealing element 118 and extends downwardly thereby. It will also be noted that the inner ends of the rotary dies 152 are bevelled as at 159 to facilitate engagement and passage of the lateral portions of the sheet 114 as the sheet moves through the machine. The rotary dies 152 function to move the lateral portions of the sheet 114 so that they extend normal to the central portion of the sheet and are brought flush against the outer surface of the inner dies 10 to complete the rectangular configuration. They also function to bring the sealing element 118 inwardly so that it will be positioned inwardly of the lip 158.

As the two sheets 111 and 114 move from station No. 7, as shown in FIG. 23, they proceed to station No. 8, which is shown in FIG. 24. It is at this station that the sealing lip 158 is brought to vertically extending position and normal to the sealing element 118. This is accomplished through the use of a pair of rotary die members indicated generally by the numeral 160, which are carried upon a transverse shaft 161 mounted for rotation upon the frame F. This shaft 161 is powered to rotate the two dies 160 at their position directly above the sealing element 118 and lip 158. Each of the dies 160 has an annular surface 162 and an adjacent radially extending surface 163 which extends outwardly therefrom at a position just outwardly of the break at the inner end of the lip 158. It also has an adjacent bevelled surface 164 which guides and cams the lip 158 into position where the surface 163 can force a sharp break or bend at the base of the lip. Cooperating with each of the rotary dies 160 is one of a second pair of rotary dies indicated generally by the numeral 165. Each of these dies is carried upon a shaft 166 which in turn is mounted upon the frame F and is likewise power driven as shown. Each of the dies 165 has an annular die surface 167 which merges with a bevelled surface 168 that extends inwardly therefrom and is adjacent to a radially extending die surface 169. The surface 169 engages the inner surface of the lip 158 and the annular surface 167 cooperates with the annular surface 162 while the bevelled surface 168 guides the lateral portions of the sheet 114 inwardly. It is at this station that the sealing lip is brought to a 90° orientation and the sealing element 118 is brought snugly up against the undersurface of the sheet 111 immediately adjacent this lip preparatory to forming a seam therewith.

As the rectangular configuration shown in FIG. 24 leaves station No. 8, it moves toward station No. 9 which is shown in FIG. 25. It is at this station that the lip 158 is brought inwardly to a partially sealing position. This is accomplished by a pair of rotary dies indicated generally by the numeral 170 and carried by a power-driven shaft 171 which is rotatably mounted on the frame F. The two rotary dies 170 are positioned just outwardly of the two fixed die members 10 and are characterized by an annular surface 172 which bears against the upper surface of the sheet 111 and cooperates with one of a pair of rotary dies indicated generally by the numeral 173. These rotary dies 173 are positioned immediately below one of the dies 170 and are characterized by a frustoconical camming surface 174 which terminates with a radially extending surface 175. These dies are mounted upon a shaft 176 which likewise is mounted upon the frame F. As these dies engage the lip 158, the end of the lip bears against the radial die surface 175 of the die 173, and the outer surface of the lip 158 is cammed inwardly by the frustoconical camming surface 174 in cooperation with the annular surface 172 of the die 170. The inner end of the die 173 bears against the outer surface of the lateral portions of the sheet 114 which has now become the sidewalls of the rectangular duct.

As the sheets leave station No. 9 which is shown in FIG. 25, they move toward station No. 10, which is shown in FIG. 26. At station No. 10 the edge portions of the sheet 111 pass between a pair of camming members 177 and 178 at each side of the rectangular duct. These camming members are flared similarly to those shown in FIG. 15 and each pair is supported upon the frame F by brackets such as indicated by the numeral 179. The camming members 177 and 178 compress the lip 158 around and upwardly against the underside of the sealing element 118 and cam these elements tightly against the underside of the portion of the sheet 111 which extends laterally beyond the sidewalls of the duct. This action is highly similar to that described with respect to the preferred embodiment as is accomplished by the structure shown in FIG. 15.

As the duct leaves station No. 10 as shown in FIG. 26, it moves to the finishing station shown in FIG. 27. At this finishing station there is provided a transverse shaft 180 which is mounted upon the frame F for rotation and is powered. It carries a pair of rotary die members indicated generally by the

numeral 181 each of which is characterized by an annular surface 182 which has a pair of recesses 183 formed in its outer surface. These rotary dies 181 cooperate with a pair of rotary dies mounted immediately therebelow and identified generally by the numeral 184. These dies likewise have an annular surface 185 which cooperate with the annular surface 182 to further compress the seam formed by the elements 118 and 158 and further carry a pair of oppositely disposed outwardly extending nipples 186 which are adapted to extend into the recesses 183 and form a button in the elements 118, 158, and the portion of the sheet 111 that extends outwardly beyond the sidewalls of the duct. In this manner, each of these elements is positively locked to the other to prevent separation during handling of the duct. The construction of the button is similar to that shown in FIG. 16.

The detailed view of FIG. 28 merely shows the manner in which the sheet 111 rides upon the channels 119 and 120 as hereinbefore described.

FIGS. 30–32 are shown herein to disclose the manner in which the seam of the first embodiment may be flattened, if such is desired. It will be readily appreciated that if it is desired to flatten the seam of the second embodiment, it may be accomplished in the same manner by merely moving the rotary die elements upwardly in position to engage the seams at the corners and cam them downwardly. As shown, the seam can be flattened by adding a station 10 immediately forwardly of station No. 9 of the first embodiment, the mechanism being comprised of two pairs of cooperating rotary dies mounted upon the frame F in position to engage the seam, the upper two dies identified by the numeral 187 being provided with a frustoconical die surface 188 which flares outwardly and cooperates with a lower die indicated generally by the numeral 189 which carries a frustoconical cooperating die surface 190. The cooperating surfaces 188 and 190 provide an initial bend to the seam so that it extends downwardly at approximately a 45° angle.

From station No. 10 as shown in FIG. 30 the duct moves to station No. 11 as shown in FIG. 31 wherein the seam at each side of the duct engages a flattening die that is mounted for rotation on the frame F. These flattening dies 191 are characterized by a flat end surface 192 and an adjacent bevelled surface 193 which together cooperate to engage and flatten the seam against the extension of the fixed inner die 10 as shown. The dies 188 and 190 and 191 can each be driven by a gear arrangement such as is shown in FIG. 32 which may be incorporated in the drive mechanism disclosed in FIG. 2.

FIG. 2 shows diagrammatically the gear train provided to drive the various rotary dies hereinbefore described so as to cause the metal sheets to be progressed through the various sequential steps hereinbefore described. A source of power (not shown) such as an electric motor is connected in driving relation to a drive gear 195. This drive gear 195 is connected in driving relation to a second drive gear 196 which is rotatably mounted upon the frame F. A drive chain 197 extends around the drive gear 196 in the manner shown to drive the interengaging assembly of gears at the front and rear end of the frame F. The location of the various stations has been indicated in FIG. 2 by identifying the various driving gears with the numerals of the shafts or rotary die members which they drive. It is believed that the interrelation of these gears and the operation of the driving train will be readily appreciated by anyone familiar with chain drives.

From the above it can be readily seen that we have provided a novel machine which utilizes a plurality of rotary dies in such a manner that a pair of flat metal sheets may be fed into one end of the machine and a completely constructed rectangular duct can be taken from the opposite end as a result of an entirely automatic operation. Since the machine is movable, it can be readily taken to any location where it is desired to utilize same, and, in fact, can be positioned adjacent an assembly line in a mobile home manufacturing plant, for example, so as to produce and discharge rectangular ducts of any desired length and feed them directly into the partially constructed home as they pass our machine in the production line. A rectangular duct of any length desired can be produced without difficulty and at a very substantial saving in cost, time and material. Moreover, there are no length limitations, and all that is required to produce a duct of a prescribed length is to provide a preprepared roll of a pair of sheets of that length and feed them into the machine.

It will, of course, be understood that various changes may be made in the form, details, arrangement and proportions of the parts without departing from the scope of this invention which consists of the matter shown and described herein and set forth in the appended claims.

What is claimed is:

1. A rectangular heat duct former capable of continuously forming a rectangular duct of conventional heat duct cross-sectional dimensions and of any appreciable length from pairs of rectangular sheets of metal, limited only by the length of such sheets, as they pass therethrough, comprising:
   a. an elongated frame, and
   b. rectangular duct-forming mechanism carried by said frame and constructed and arranged to continuously form in progressive stages ducts which have rectangular heat duct cross-sectional dimensions and configuration from pairs of such rectangular sheets of metal as they pass through said mechanism, said duct-forming mechanism including:
      1. two series of successive pairs of cooperative rotary die members
      2. each of said series being disposed along one of a pair of spaced metal-sheet paths extending longitudinally of said frame
      3. said pairs of cooperative rotary die members of each of said series being mounted for rotation upon said frame at spaced locations along the length of said frame and being constructed and arranged to engage the lateral portions of such sheets at each side thereof to cooperatively and progressively shape each of such pairs of sheets into an elongated rectangular duct as they pass longitudinally through said mechanism,
      4. some of said pairs of cooperative rotary die members being also disposed at locations spaced transversely of said frame at opposite sides of such sheets in position to engage them at their lateral portions as they pass through said mechanism, and
      5. progression means supported adjacent said series of rotary die members and constructed and arranged to engage and move a pair of such sheets of metal longitudinally through said mechanism in spaced relation to each other and in position to be engaged at their lateral portions and so shaped by said cooperative rotary die members.

2. The structure defined in claim 1 wherein said progression means is powered and rotary and constructed and arranged to engage each of such sheets at various locations spaced transversely thereacross and inwardly of their extreme lateral portions.

3. The structure defined in claim 1, and a single roll of sheet metal supported adjacent said duct-forming mechanism and comprised of a pair of elongated flat sheets of metal disposed in superimposed contiguous relation and rolled into a single roll in concentric and contiguous convolutions, the sheets thereof extending into said duct-forming mechanism and the lateral portions thereof being engaged by said rotary die members in shaping relation.

4. The structure defined in claim 1 and a pair of separate rolls of elongated flat sheets of metal supported adjacent said duct-forming mechanism, each of said sheets extending from one of said rolls into said duct-forming mechanism in juxtaposed relation and being engaged in shaping relation at their lateral portions by said rotary die members.

5. The structure defined in claim 1 wherein said rotary die members are arranged in vertically spaced sets.

6. The structure defined in claim 1 wherein some of said rotary dies are juxtaposed relative to other of said dies with respect to such sheets of metal so as to engage and simultaneously shape opposite lateral portions of such sheets as they pass through said mechanism.

7. The structure defined in claim 1, wherein said duct-forming mechanism also includes:

6. a fixed die member carried by said frame and extending longitudinally thereof, and

7. a plurality of rotary members rotatably mounted on said frame adjacent said fixed die member and constructed and arranged with respect thereto to engage and cooperatively shape lateral portions of such sheets as the latter pass longitudinally through said mechanism and thereby form such sheets progressively along their length into a duct having a rectangular configuration.

8. The structure defined in claim 1, wherein said duct-forming mechanism also includes:

6. a fixed die member carried by said frame and extending longitudinally thereof, and

7. a plurality of camming members mounted on said frame adjacent said fixed die member and constructed and arranged with respect thereto to engage and cooperatively shape lateral portions of such sheets as the latter pass longitudinally through said mechanism and thereby form such sheets progressively along their lengths into a duct having a rectangular configuration.

9. The structure defined in claim 1 wherein said rotary die members are power driven.

10. The structure defined in claim 1 wherein said forming mechanism includes securing means for securing the adjacent lateral portions of said sheets to each other.

11. The structure defined in claim 1 wherein said forming mechanism includes securing means constructed and arranged to permanently lock the adjacent lateral portions of said sheets to each other after they have been so shaped.

12. The structure defined in claim 1 wherein said duct-forming mechanism includes seam-forming mechanism and said seam-forming mechanism includes rotary die members.

13. The structure defined in claim 1, wherein said duct-forming mechanism includes seam-forming mechanism carried by said frame.

14. The structure defined in claim 1 wherein said duct-forming mechanism includes seam-forming mechanism and seam-flattening mechanism, said seam-flattening mechanism being constructed and arranged to flatten the seam formed by said seam-forming mechanism against the sidewall of the rectangular duct formed by said duct-forming mechanism.

15. The structure defined in claim 1 wherein said duct-forming mechanism includes seam-forming mechanism and seam-flattening mechanism, said seam-flattening mechanism including at least one rotary die member.

16. The structure defined in claim 1 wherein said duct-forming mechanism is constructed and arranged to engage and shape such sheets into elongated generally U-shaped channels facing each other with their lateral portions extending toward each other to define a rectangular duct and includes rotary members constructed and arranged to form an interlocking seam of said lateral portions intermediate the corners and at each of one of a pair of opposite sides of such rectangular ducts.

17. The structure defined in claim 1 wherein said duct-forming mechanism is constructed and arranged to engage and shape such sheets into elongated angulated channels facing each other with their lateral portions extending toward and adjacent each other to cooperatively define a rectangular duct and includes rotary members constructed and arranged to form an interlocking seam of said lateral portions adjacent one corner and at each one of a pair of opposite sides of such rectangular ducts.

18. The structure defined in claim 1 wherein said duct-forming mechanism includes pairs of cooperating rotary die members constructed and arranged to engage and shape the outermore lateral portions of such sheets into angular seam-forming shapes, and also including additional rotary die members spaced from and constructed and arranged behind said first-mentioned die members to engage innermore lateral portions of such sheets and shape the same into opposed adjacent channel members of generally U-shaped configuration in cross section and facing each other.

19. A rectangular heat duct former capable of continuously forming a rectangular duct of conventional heat duct cross-sectional dimensions and of any appreciable length from pairs of rectangular sheets of metal, limited only by the length of such sheets, as they pass therethrough, comprising:

a. an elongated frame, and

b. rectangular duct-forming mechanism carried by said frame and constructed and arranged to continuously form in progressive stages ducts which have rectangular heat duct cross-sectional dimensions and configuration from pairs of such rectangular sheets of metal as they pass through said mechanism, said duct-forming mechanism including:

1. two series of successive pairs of cooperative rotary die members
2. each of said series being disposed along one of a pair of spaced metal-sheet paths extending longitudinally of said frame
3. said pairs of cooperative rotary die members of each of said series being mounted for rotation upon said frame at spaced locations along the length of said frame and being constructed and arranged to engage the lateral portions of such sheets at each side thereof to cooperatively and progressively shape each of such pairs of sheets into an elongated rectangular duct as they pass longitudinally through said mechanism,
4. some of said pairs of cooperative rotary die members being also disposed at locations spaced transversely of said frame at opposite sides of such sheets in position to engage them at their lateral portions as they pass through said mechanism,
5. progression means supported adjacent said series of rotary die members and constructed and arranged to engage and move a pair of such sheets of metal longitudinally through said mechanism in spaced relation to each other and in position to be engaged at their lateral portions and so shaped by said cooperative rotary die members, and
6. some of said pairs of cooperative rotary die members being also disposed at locations spaced from each other in at least two transverse directions relative to said frame.

20. The structure defined in claim 19 and a cradle mounted adjacent one end of said frame and constructed and arranged to receive and support at least one preprepared roll of a pair of elongated contiguous metal sheets in position to be fed into said duct-forming mechanism in superimposed relation to each other.

21. The structure defined in claim 19 and cradle structure mounted adjacent one end of said frame and constructed and arranged to receive and support a pair of rolls of elongated flat sheets of metal in position to be fed into said duct-forming mechanism in superimposed relation to each other.

22. The structure defined in claim 19 wherein said duct-forming mechanism is constructed and arranged to engage and shape such sheets into elongated generally U-shaped channels facing each other with their lateral portions extending toward each other to define a rectangular duct and includes rotary members constructed and arranged to form an interlocking seam of said lateral portions intermediate the corners and at each of one of a pair of opposite sides of such rectangular ducts.

23. The structure defined in claim 19 wherein said duct-forming mechanism is constructed and arranged to engage and shape such sheets into elongated angulated channels facing each other with their lateral portions extending toward and adjacent each other to cooperatively define a rectangular duct and includes rotary members constructed and arranged to form an interlocking seam of said lateral portions adjacent one corner and at each one of a pair of opposite sides of such rectangular ducts.

24. The structure defined in claim 19 wherein said forming mechanism includes cooperative fixed and rotary die members.

25. The structure defined in claim 19 wherein said feeding means includes a roller having a resilient sheet engaging surface.

26. The structure defined in claim 19 and rotary support members supporting said frame and adapting the same for ready movement of said duct-forming mechanism and said frame from one manufacturing location to another.

27. The structure defined in claim 19 wherein said pairs of rotary die members are disposed at multiple elevations upon said frame.

28. The structure defined in claim 19 and a pair of elongated rectangular sheets of metal fed into said duct-forming mechanism in spaced relation to each other.

29. The structure defined in claim 19 wherein said duct-forming mechanism includes:

7. seam-forming mechanism carried by said frame and constructed and arranged to engage the extreme lateral portions of such sheets of metal and form a seam therefrom, and

8. seam-deforming mechanism carried by said frame and constructed and arranged to progressively deform portions of the seam so formed as such sheets move through said mechanism to positively interlock such seam portions.

30. The structure defined in claim 19 wherein said duct-forming mechanism includes:

7. a fixed die member carried by said frame and extending longitudinally thereof, and

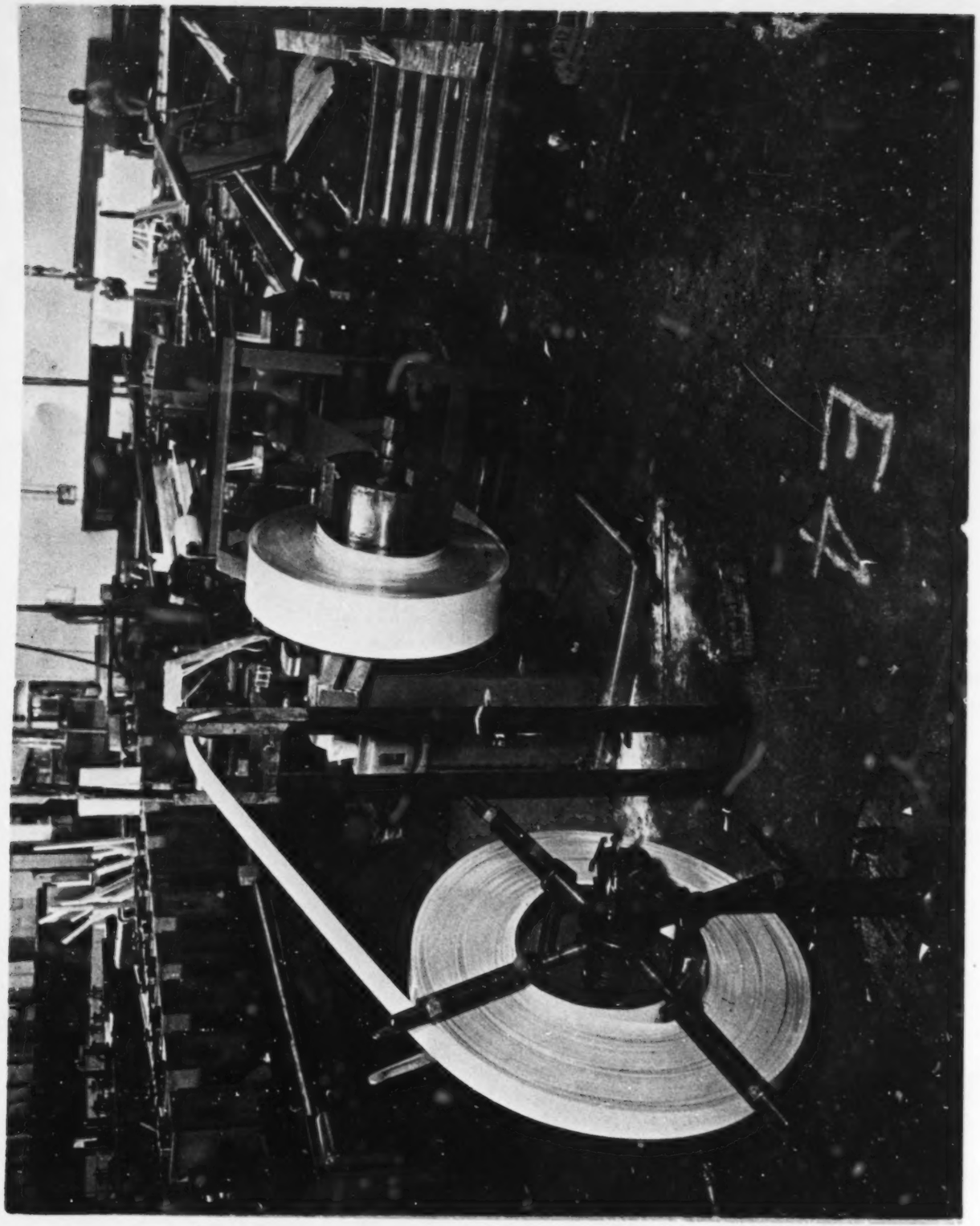
8. a plurality of camming rollers mounted on said frame for rotation about nonparallel axes adjacent said fixed die member and constructed and arranged with respect thereto to engage and cooperatively shape lateral portions of such sheets as the latter pass longitudinally through said mechanism and thereby form such sheets progressively along their lengths into a duct having a rectangular configuration.

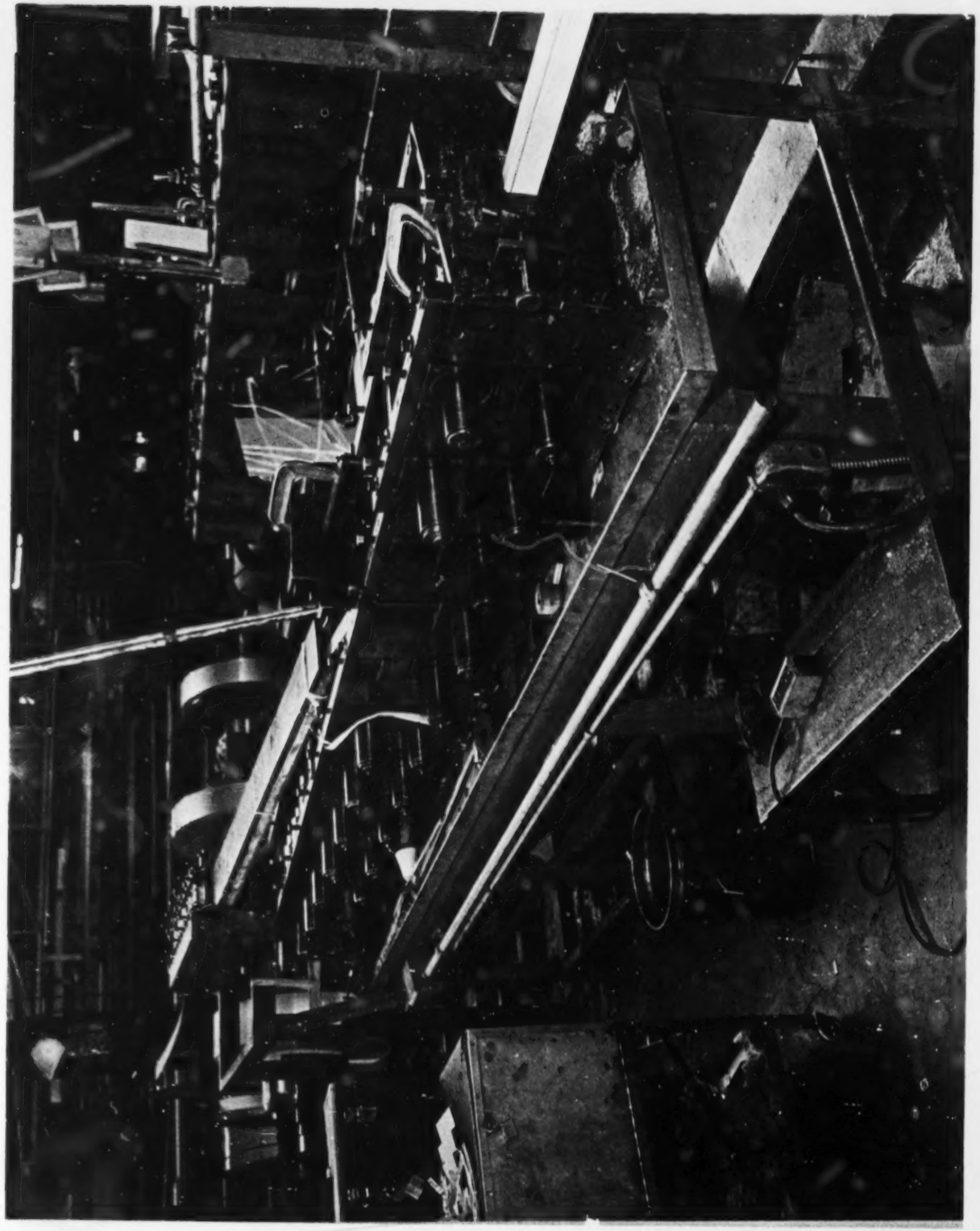
31. The structure defined in claim 30 wherein said camming rollers are disposed at a multiple of levels.

32. The structure defined in claim 19 wherein said duct-forming mechanism includes:

7. a plurality of cooperative pairs of spaced rotary wall-stiffening dies carried by said frame and constructed and arranged to receive such sheets of metal therebetween and progressively form wall-stiffening ribs in such sheets as they pass longitudinally therethrough.

* * * * *





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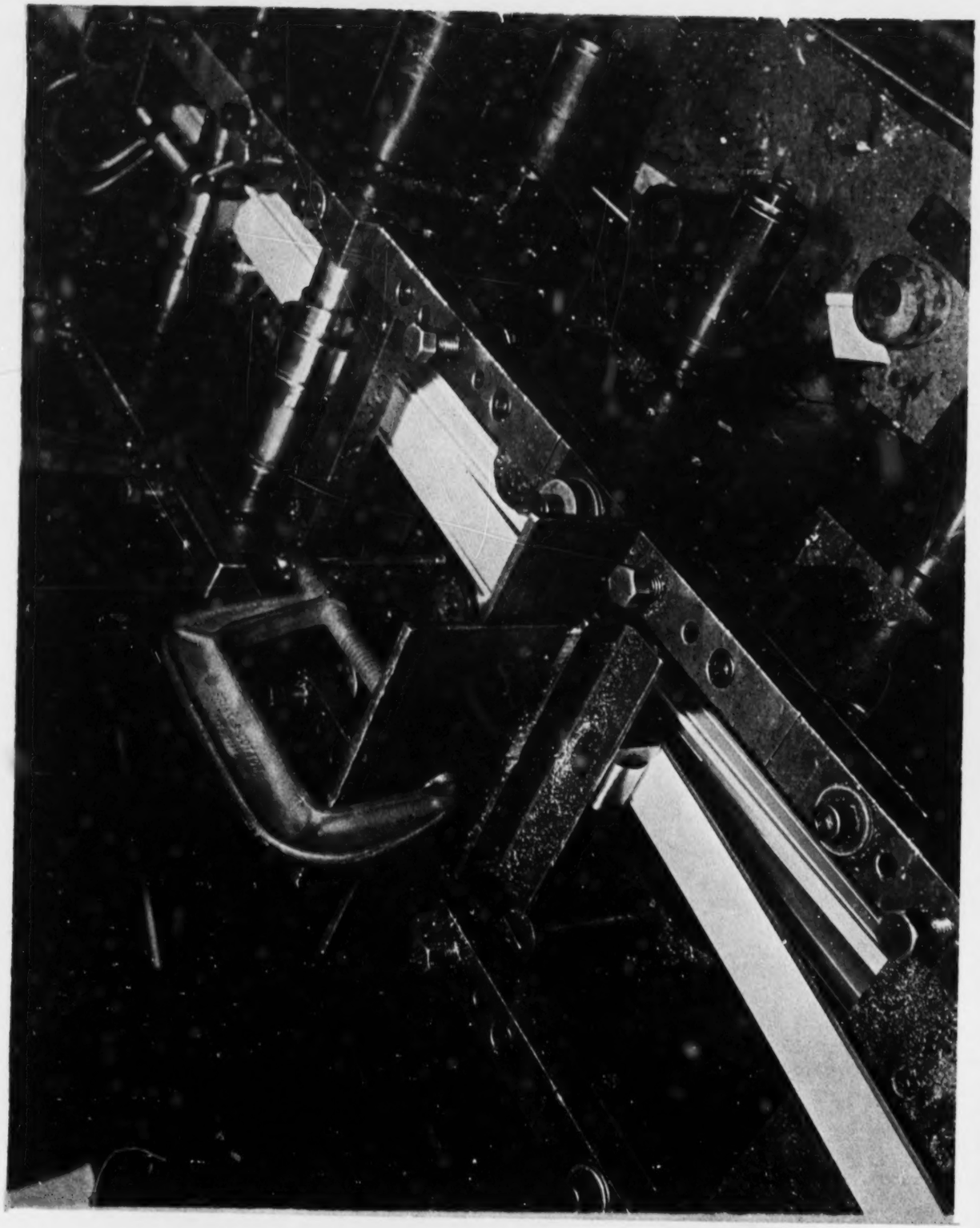

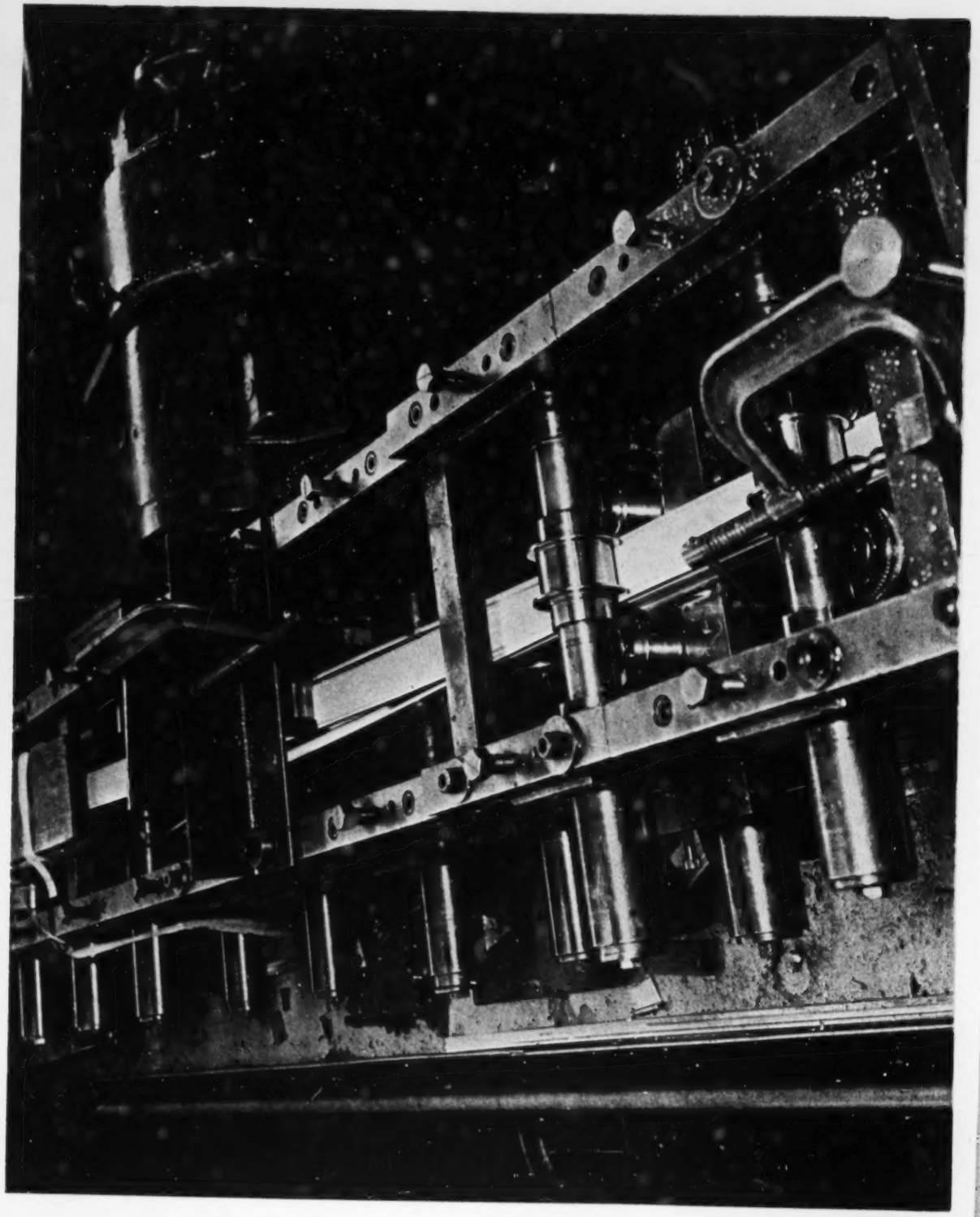

United States Patent

[11] 3,545,496

[72] Inventor Alfred Wogerbauer
Linz, Austria

[21] Appl. No. 651,836
[22] Filed July 7, 1967
[45] Patented Dec. 8, 1970

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[32] Priority Aug. 9, 1966
[33] Austria
[31] No. A7605/66

[54] **FOLD FLANGE TUBE AND PROCESS AND INSTALLATION FOR PRODUCING SUCH FOLD FLANGE TUBES**
1 Claim, 50 Drawing Figs.

[52] U.S. Cl. 138/171, 219/59. 219/67; 138/156. 138/178
[51] Int. Cl. F16l 9/22
[50] Field of Search 138/106, 157, 156, 158, 170, 171, 177, 178; 219/67, 59

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Primary Examiner—Herbert F. Ross
Attorney—Brumbaugh, Graves, Donohue & Raymond

ABSTRACT: The invention relates to fold flange tubes made from two component sections joined by welding, at least one of said component sections comprising one or several fold flanges, and provides a process for producing such fold flange tubes from strip stock in a continuous manner and in a single plant, and an installation for carrying out this process.

FIG. 1

FIG. 1a

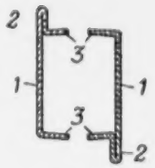

FIG. 2

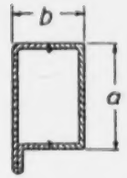

FIG. 2a

FIG. 3

FIG. 3a

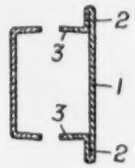

FIG. 4

FIG. 4a

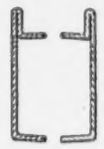

FIG. 5

FIG. 5a

FIG. 6

FIG. 6a

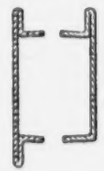

FIG. 7

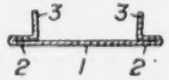

FIG. 8

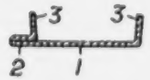

FIG. 9

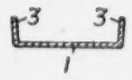

FIG. 10

FIG. 10a

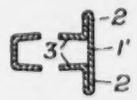

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FIG. 11

FIG. 11a

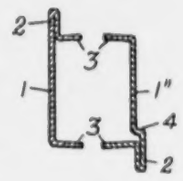


FIG. 12

FIG. 12a

FIG. 13

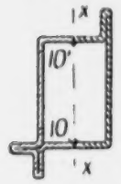


FIG. 13a

FIG. 14

FIG. 14a

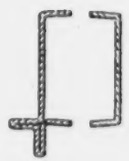


FIG. 15

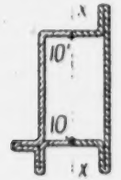


FIG. 15a

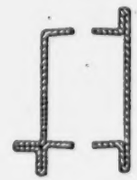


FIG. 16

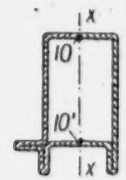


FIG. 16a

FIG. 17

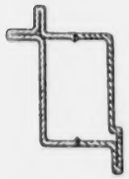


FIG. 17a

FIG. 18

FIG. 18a

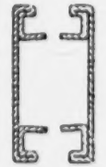


FIG. 19

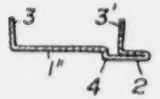


FIG. 20

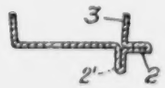
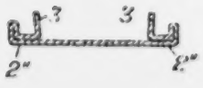


FIG. 21



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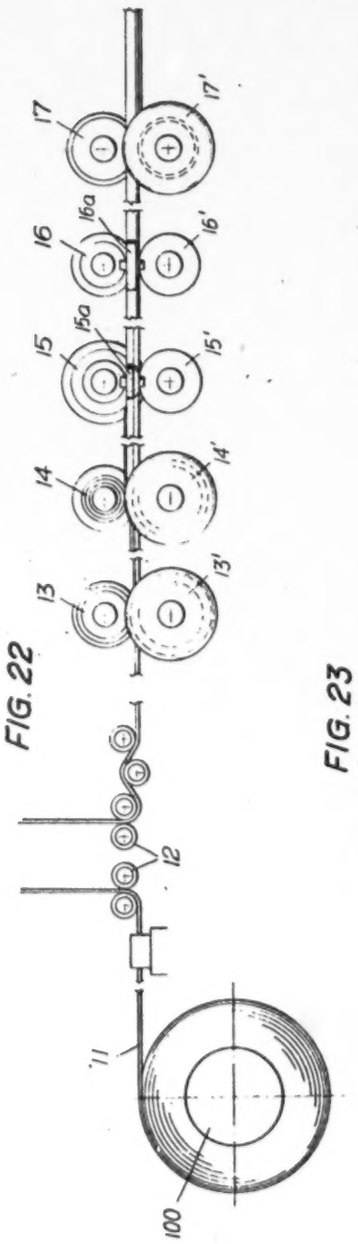

FIG. 22

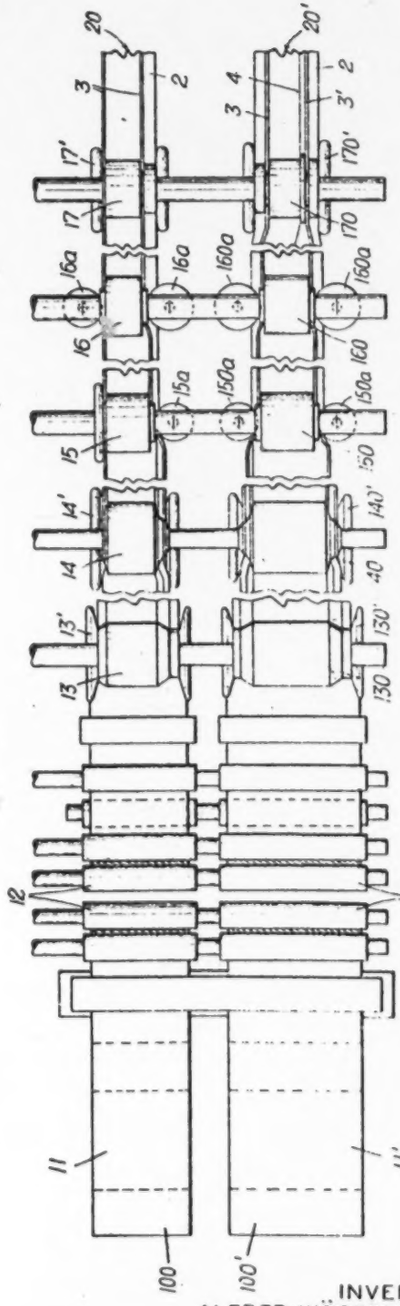

FIG. 23

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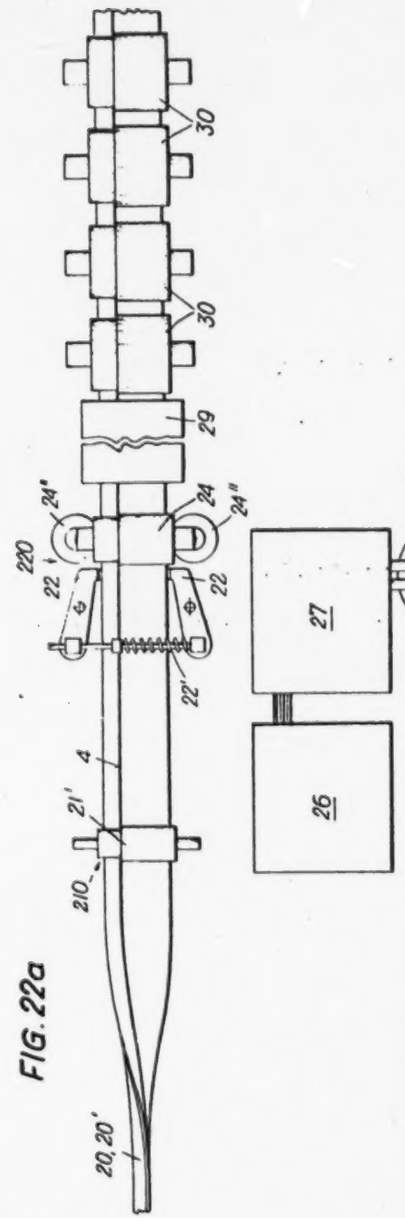

FIG. 22a

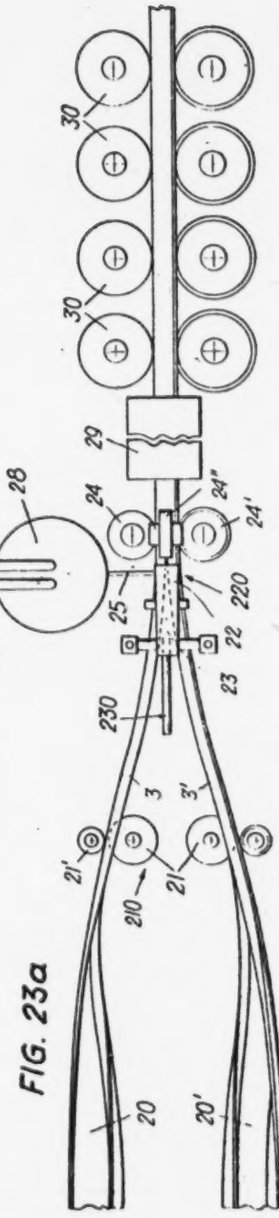

FIG. 23a

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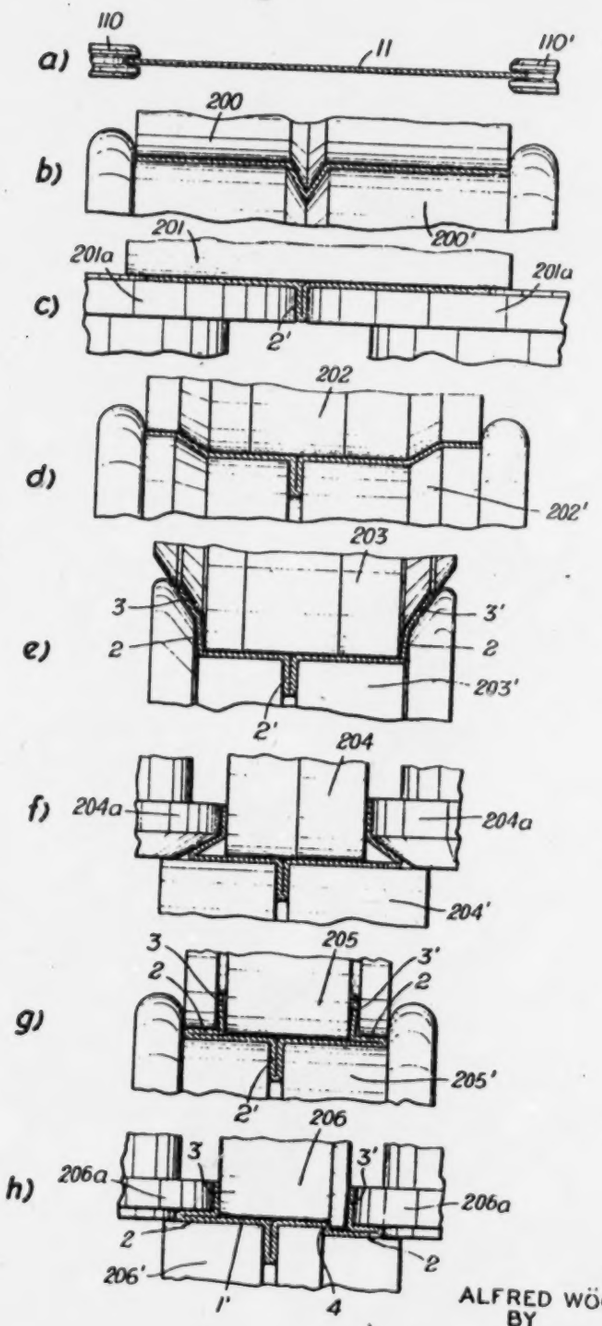

FIG. 24

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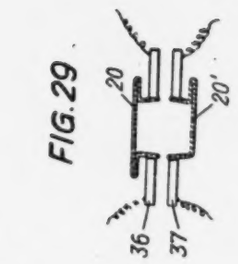

FIG. 29

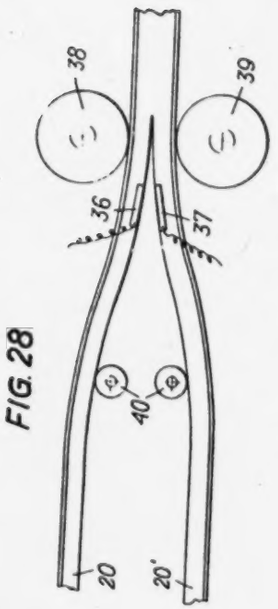

FIG. 28

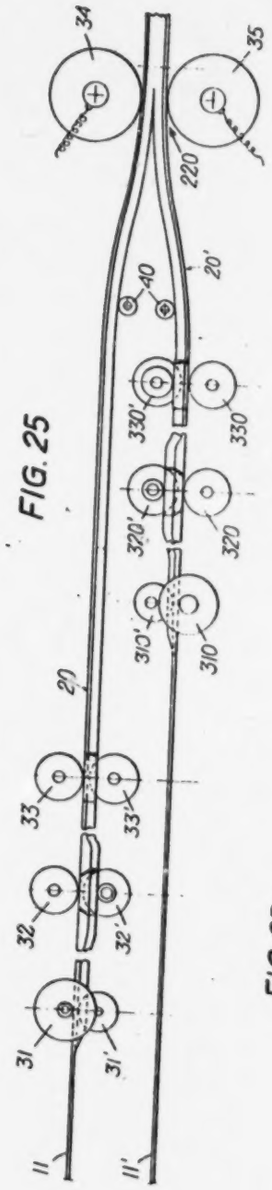

FIG. 25

FIG. 25b

FIG. 25a

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FIG. 27

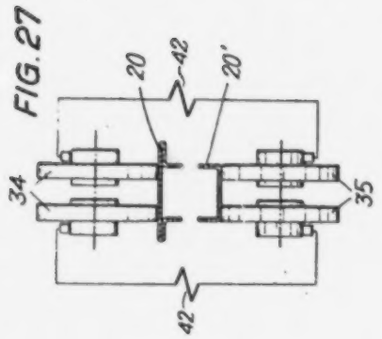
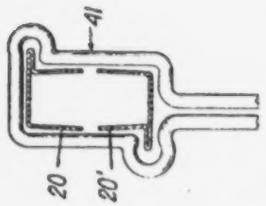


FIG. 31



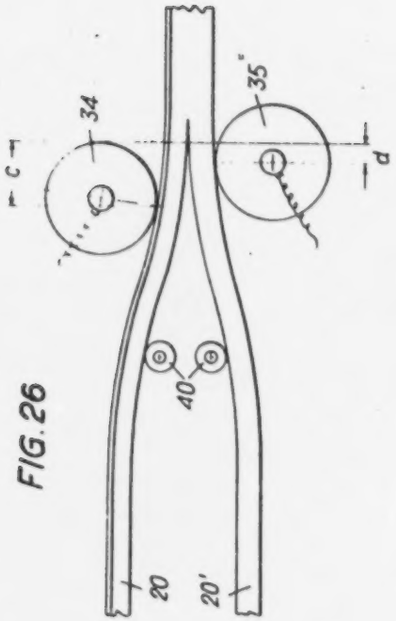


FIG. 26

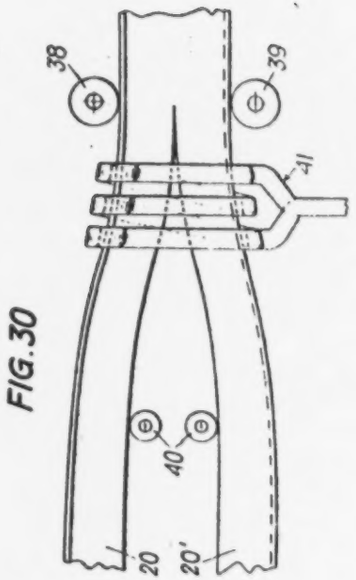


FIG. 30

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1

FOLD FLANGE TUBE AND PROCESS AND INSTALLATION FOR PRODUCING SUCH FOLD FLANGE TUBES

The invention relates to a fold flange tube and to processes and installations for producing such fold flange tubes from metal strips.

Fold flange or lap tubes are increasingly used by building fitters, in portal building, and the like, for making doors, windows, frames, etc. Originally, fold flange tubes were exclusively produced by reshaping of round tubes upon draw benches. This process is expensive, as it requires many separate steps and a considerable amount of material. Further, fold flange tubes are also produced in a tube welding plant where preshaped tubes instead of round tubes are made. Such tubes receive the desired shape by a final cold-draw. This process requires multiple-stand welding machines and complicated tooling equipment so that fold flange tubes produced by this process are expensive. With increasingly complicated shapes, this process becomes ever less economical. The limit is apparently a maximum of three fold flanges.

The invention aims at avoiding these disadvantages and difficulties. In particular, it has as its object to produce fold flange tubes from strip stock in a continuous manner and in a single plant.

A further object is the production of fold flange tubes of complicated shape, i.e. such having four to eight fold flanges, with a comparatively small set of tools.

The fold flange tube of the invention with which these objects are achieved is characterized in that it is made from two component sections joined by welding, at least one of said component sections having one or several fold flanges.

Preferably, the connecting welds lie opposite each other in a plane passing through the middle axis of the fold flange section.

The process of the invention for the production of fold flange tubes of the above characteristics comprises continuously passing two metal strips through successive shaping stations to form component sections of which at least one is provided with one or several fold flanges, and bringing said component sections together so that their edges to be welded face each other and joining said edges by butt welding to form a finished section.

According to a modified embodiment, the two strips are rolled into shape in one plane parallel to each other, whereupon the component sections are twisted towards each other and the edges are welded.

According to another embodiment, the strips are shaped to component sections in superposed planes and the two component sections are then vertically approached so that the edges which are to be welded contact.

The invention is illustrated in the drawing by way of several exemplary embodiments. In addition, the process of the invention and the installations used for carrying out this process are diagrammatically illustrated in the drawing.

FIGS. **1**, **2**, **3**, **4**, **5**, and **6** show six basic types of fold flange tubes according to the invention, FIGS. **1***a*, **2***a*, **3***a*, **4***a*, **5***a*, and **6***a*, respectively, demonstrating the two components which are joined by welding to form the pertinent fold flange tube. These components can be traced back to the three basic shapes shown in FIGS. **7**, **8**, and **9**. The basic shape shown in FIG. **7** has a trough-shaped profile and comprises the web **1**, two fold flanges **2**, and the projecting branches **3**. The basic shape according to FIG. **8** also has a trough-shaped profile and comprises web **1**, one single fold flange **2**, and branches **3**, and the basic shape according to FIG. **9**, which is simply U-shaped, comprises the web **1** and the two branches **3**.

The fold flange tube according to FIG. **1** is thus composed of two component sections according to FIG. **8** having only one fold flange **2**, the fold flange tube according to FIG. **2** of one basic shape according to FIG. **8** and one according to FIG. **9**, the fold flange tube according to FIG. **3** of one basic shape according to FIG. **9** and one according to FIG. **7**, etc., as evident from the drawing.

2

As shown in FIGS. **1** to **9**, the height *b* of the two branches **3** as well as the width *a* of web **1** are equal in all these embodiments. Thus, all combinations have the same interior cross section so that the types shown in FIGS. **1** to **6** are also interconnectable, e.g. by means of corner connections to form frames, without detracting from the stability of the construction as a whole.

FIGS. **10** and **10***a* show a modified embodiment in which, although the height of the branch is the same as shown in the basic shapes according to FIGS. **7** to **9**, the width of the web **1'** is smaller. Such embodiments in which one dimension corresponds to that of the embodiments according to FIGS. **1** to **9** and the other dimension is smaller, can also be used in frames, for instance as cross bars.

FIGS. **11**, **11***a*, **12**, **12***a*, **13**, **13***a*, **14**, **14***a*, **15**, **15***a*, **16**, **16***a*, **17**, **17***a*, and **18**, **18***a* show further embodiments of fold flange tubes derivable from basic shapes of FIGS. **19** to **21** and eventually from those of FIGS. **7** to **9**. For instance, the basic shape according to FIG. **19** differs in that the web **1''** has a steplike recess **4** continued in a fold flange **2**, to which the one branch **3'**, which is longer by the thickness of the metal sheet than the other branch **3**, is attached at right angles. FIG. **20** shows two fold flanges **2** and **2'** arranged at right angles to each other and to the one branch **3**. The basic shape according to FIG. **21** is characterized in that the fold flanges **2''** are longer than in the previously described embodiments, and flexed, and have shorter branches **3**.

As shown, the fold flange tube according to FIG. **11** is composed of a basic shape according to FIG. **19** and one according to FIG. **8**; the fold flange tube according to FIG. **12** of one basic shape according to FIG. **19** and one according to FIG. **9**, the fold flange tube according to FIG. **13** of one basic shape according to FIG. **8** and one according to FIG. **20**, etc. The fold flange tube according to FIG. **18** is composed of two basic shapes according to FIG. **21**.

In all these embodiments, the welding seams **10** and **10'** are arranged opposite each other in a plane *x–x* extending through the middle axis of the fold flange tubes.

FIGS. **22** and **23**, one showing a lateral view and the other a top view, illustrate the process according to the invention in its continuous steps. According to this illustration, the starting material are two strips arranged in parallel in a horizontal plane, said strips being drawn off supply cylinders **100**, **100'**. The strips **11**, **11'** are passed over guide pulleys **12**, **12'** to form a loop and are then shaped to one of the basic shapes according to FIG. **8** (strip **11**) or FIG. **19** (strip **11'**) in a series of pairs of shaping rolls: **13**, **13'**, **14**, **14'**, **15**, **15'**, **16**, **16'**, **17**, **17'** as well as rolls **15***a* and **16***a* for strip **11**, and pairs of shaping rolls **130**, **130'**, **140**, **140'**, **150**, **150'**, **160**, **160'**, **170**, **170'** as well as rolls **150***a* and **160***a* for strip **11'**. It must be remarked that in practice, depending upon the kind of component section to be made, more than five shaping stations are required.

FIG. **24** illustrates the production of a section similar to that of FIG. **19**, showing the successive stages of the shaping process. Stage (*a*) shows a flat strip **11** between two guide pulleys **110** and **110'**; in stage (b) a bead longitudinal of the direction of the strip is shaped by means of two shaping rolls **200**, **200'** and in stage (*c*) is rolled by means of two shaping rolls **201***a* to form a flat flange **2'**, while a further, smooth roll prevents warping of the shaped strip. In stages (*d*) and (*e*), the side flanges **2** and branches **3**, **3'** are preshaped by further shaping rolls **202**, **202'**, and **203**, **203'**. In stages (*f*) and (*g*), the flanges **2** and branches **3**, **3'** receive their final shape through rolls **204**, **204'**, **205**, **205'**, and the pair of rolls **204***a*. In stage (*h*), the step **4** in web **1'** is formed by the rolls **206**, **206'**, and the pair of rolls **206***a*.

The shaping rolls may be assembled from component parts so that sections of varying width can be produced with a small number of roll parts. In a similar manner, all the basic shapes according to FIGS. **7** to **9** and **19** to **21**, respectively, as well as any desired modifications of these basic shapes can be produced.

FIGS. 22*a* and 23*a* show the continuation of the installation illustrated in FIGS. 22 and 23. The component fold flange sections 20 and 20' are twisted towards each other between the last pair of shaping rolls (17, 17', and 170, 170'; FIGS. 22 and 23) and a twisting roll stand 210 comprising rolls 21, 21', 21'' so that the branches 3, 3' come to face each other, as shown in FIGS. 1*a* to 6*a* and 11*a* to 18*a*. In this position, the facing component sections 20, 20' enter the welding machine 220. The welding machine comprises, as known per se, a straddling device 230, e.g. a mandrel 23 or pulleys 40, pressure rollers 24, 24', 24'', and two welding jaws 22 pressed against component sections 20, 20' by means of a spring 22', said welding jaws receiving the required current through a welding current line 25. The welding process is based on the principle of bringing the edges of branches 3, 3' together at an acute angle to form a so-called notch wherearound the electric current circulates in high concentration and effects the welding. Numeral 26 denotes a rectifier, 27 a high frequency generator and 28 a matching transformer. 29 is a cooling device and 30 a set of stretching and straightening rollers.

FIG. 25 shows a modified version of the production process in which two series of shape rolling stands comprising pairs of shaping rolls are arranged in staggered relationship in a vertical plane rather than side by side as in FIG. 23. Strip 11 enters the first series of shape rolling stands, three of which, 31, 31', 32, 32', and 33, 33', are illustrated, wherein strip 11 is shaped as shown in FIG. 25*a*, while strip 11' remains unshaped. In the second series of shape rolling stands arranged behind and below the first series, whereof again three roll pairs are designated by 310, 310', 320, 320', and 330, 330', the section 20 remains undeformed, as shown in FIG. 25*b*, while the strip 11' is shaped to section 20'. In this modified version of the process the sections need not be twisted towards each other, but are vertically approached until the branch edges to be welded come to face each other, and are then welded in welding machine 220. The production process as illustrated in FIG. 25 is to be preferred if comparatively complicated profiles with several fold flanges, which present a greater resistance to twisting, are to be produced. FIGS. 26 and 27 illustrate a possible welding current supply, FIGS. 28 and 29 another possibility and FIGS. 30 and 31 a third possibility. In the version according to FIGS. 26 and 27, low frequency current is supplied from a transformer 42 by way of electrode rollers 34, 35, which are staggered in the feed direction of the sections 20, 20'. The rollers 34 and 35 are adjustable in feed direction and also in relation to each other, according to the dimensions *e*, *d*. This adjustability has the purpose that, when using low frequency welding current, and when the fold flange tubes are unsymmetrical, the problem arises of uniformly heating the two butting branches. When a U-section branch having a fold flange lies opposite another branch having no such flange, the branch of the U-section with fold flange would remain cooler than the branch without fold flange. The adjustability of the current supply rollers makes it possible to exclude differential heating.

FIGS. 28 and 29 show a preferred method of welding using high frequency current supplied through sliding contacts 36 and 37. Numerals 38 and 39 again denote the pressure rollers, numeral 40 the straddling rollers.

According to FIGS. 30 and 31, the welding current is supplied by way of an induction coil 41 surrounding the section at an even distance, which induces an adequate current in component sections 20 and 20' the circuit being closed by the butting branch edges which are thereby heated and joined. Numerals 38 and 39 again denote the pressure rollers and numeral 40 the straddling rollers.

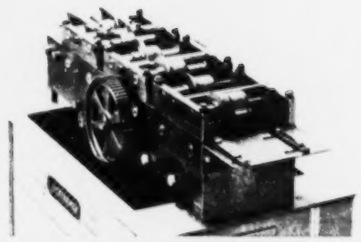
I claim:

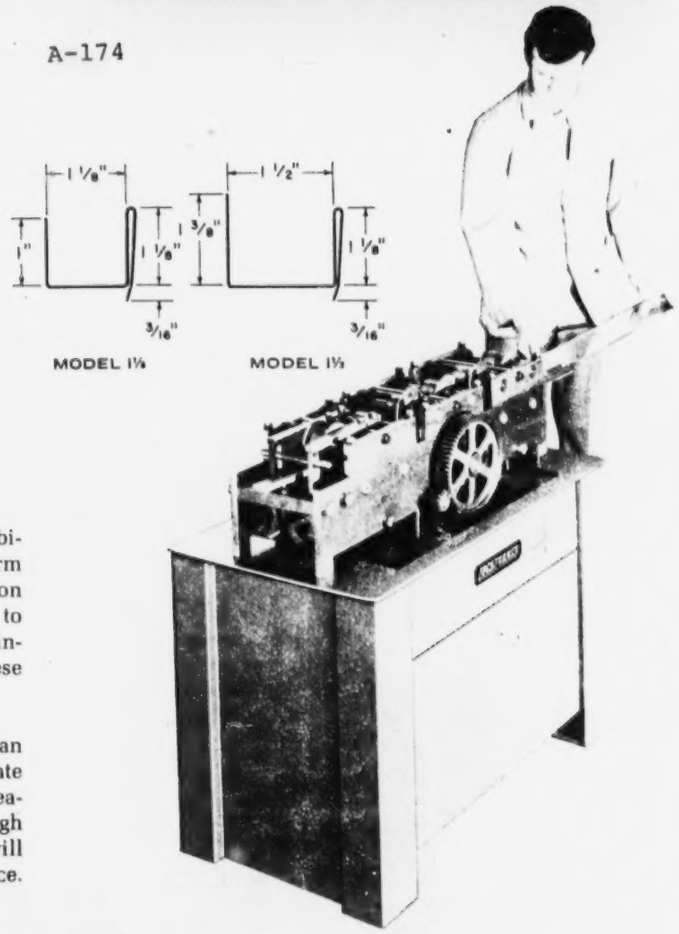
1. A fold flange tube comprising, a pair of longitudinal component sections joined together by butt welding, the welding seams being disposed opposite each other in a plane passing through the middle axis of said tube, at least one of said component sections having at least one fold flange disposed in a plane parallel to the plane defined by said welding seams.

CLIPROL — Models 1½" and 1⅛"

DUCT CONNECTOR MACHINES

A-174





The Lockformer Cliprol is a precision-built, combination roller-die and forming machine to form government cup clips (pocket locks) at production speed of 70 to 80 fpm. Available in two models, to form the cup clip, or pocket lock, shape on the inboard side, handling pieces as short as 6". These clips meet government specifications.

Compared to hand brake methods, the Cliprol can save up to 40% in time and labor needed to fabricate government clips and completely eliminates measuring or bending mistakes. Made to the same high standards as other Lockformer equipment, it will provide many years of accurate, dependable service.

SPECIFICATIONS

	Model 1⅛"	Model 1½"
Capacity:	Up to 22 ga. galvanized; up to .040" aluminum.	Up to 22 ga. galvanized; up to .040" aluminum.
Forming Speed:	70 to 80 fpm.	70 to 80 fpm.
Clip Length:	From 6" up.	From 6" up.
Centers:	Vertical center distance, 3½"; horizontal center distance, 5½" for forming rolls.	Vertical center distance, 3½"; horizontal center distance, 5½" for forming rolls.
Material Used:	4⅜" to 4⅝" (Stock width variable by entrance gauge shift adjustment.)	5⅛" to 5⅜" (Stock width variable by entrance gauge shift adjustment.)
Extended Lip:	Approximately 3/16"	Approximately 3/16"
Motor:	3 H.P., 230/460 volts, 60 cycle, 3 phase, 1800 R.P.M. Across-the-line manual type starter. (Other electrics available on request.)	3 H.P., 230/460 volts, 60 cycle, 3 phase, 1800 R.P.M. Across-the-line manual type starter. (Other electrics available on request.)
Drive:	Single V-Belt.	Single V-Belt.
Base:	Welded steel; 6 all-steel forming stations.	Welded steel; 6 all-steel forming stations.
Dimensions:	Approx. 48" long, 22" wide, 40" high.	Approx. 48" long, 22" wide, 40" high.
Shipping Weight:	Approx. 550 lbs.	Approx. 550 lbs.
General:	Drawn shell needle bearings; oilite thrust bearings. All bearing surfaces ground. Case hardened forming rolls and shafts. Machine cut gears. Alemite pressure lubrication to all high speed reduction bearings.	Drawn shell needle bearings; oilite thrust bearings. All bearing surfaces ground. Case hardened forming rolls and shafts. Machine cut gears. Alemite pressure lubrication fittings to all high speed reduction bearings.

A-175

INDUSTRIES, INC.
P. O. BOX 185, ELKHART, INDIANA 46514 • TELEPHONE 219-523-0177

February 22, 1971

Richard Littleton
5505 North Ocean Boulevard
Cambridge Apartment 206
Del Rey Beach, Florida 33444

Dear Dick:

Please consider this as an idem to the letter delivered to you by Glenn Moon.

After due consideration, it appears to me that any substantial changes on the existing "zip duct" could possibly require an outstanding amount of development time. Because of the penetration this company has been able to achieve, I feel we should concentrate on duplicating or copying the existing machine. It is my understanding that there is a patent pending on this device; so some thought must be given in order to surmount this liability.

It is my intent to have Al McDowell begin duplicating exactly the existing machine and then changes can be made.

If you have any ideas or comments please advise.

Very truly yours,

Rex Simpson
President

do

MANUFACTURERS SYSTEMS, INC.

DUCT FORMING MACHINES MANUFACTURED BY M.S.I.

YEAR	NEW MACHINES PRODUCED	ESTIMATED NUMBER OF MACHINES CONVERTED (DIFFERENT SIZE)
1970	15	-0-
1971	87	-0-
1972	87	2
1973	105	6
1974	67	15
1975	1	20
1976	4	32

TOTAL PRODUCED AND CONVERTED = 439

DUCT FORMING MACHINES NOT IN USE

STANDBY (IDLE) MACHINES

YEAR	NUMBER OF MACHINES
1970	-0-
1971	-0-
1972	2
1973	3
1974	11
1975	34
1976	81
1977	86

SCHEDULE OF RENTAL & ROYALTY INCOME

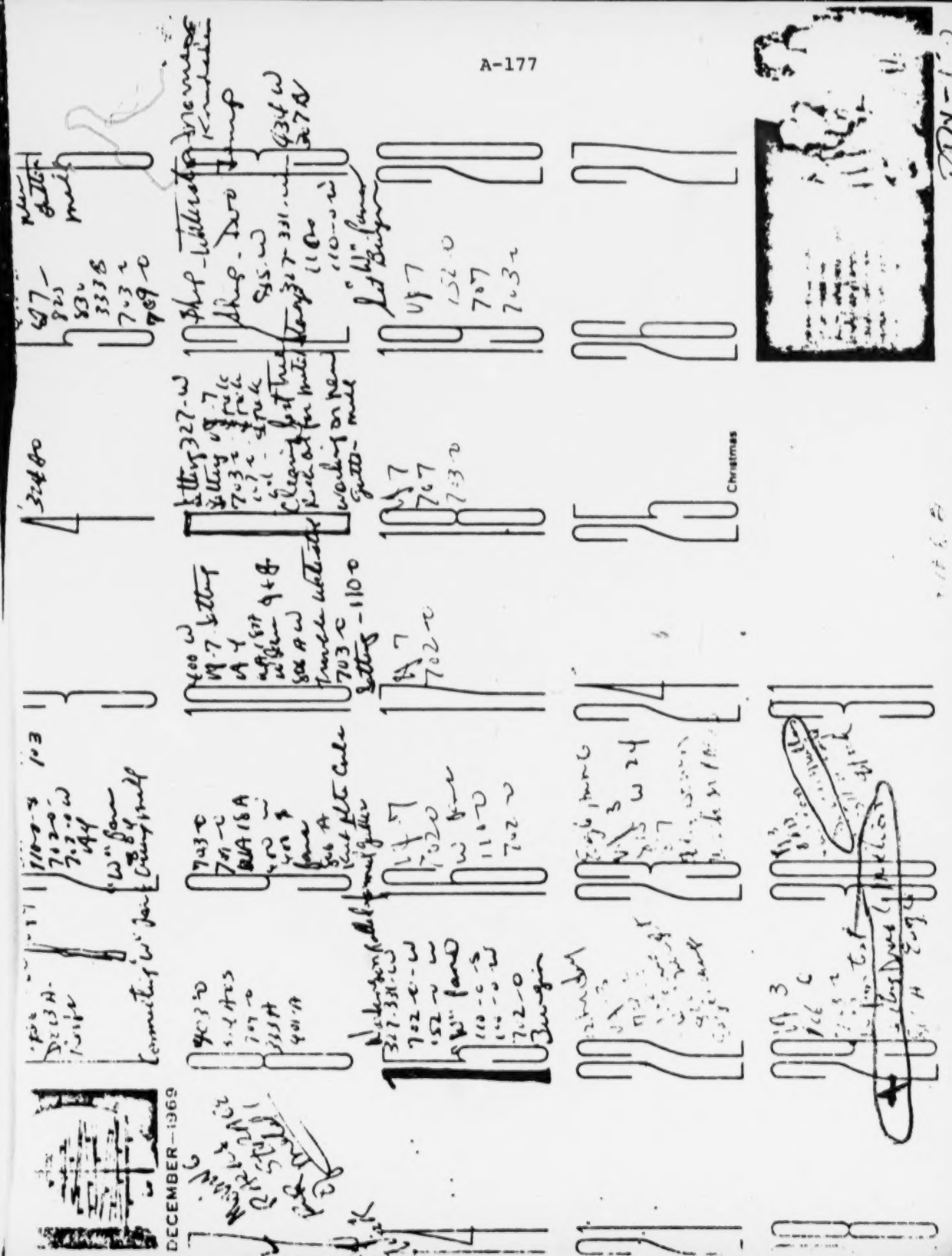
FISCAL	TOTAL RENTAL & ROYALTY INCOME	RENTAL INCOME	ROYALTY INCOME
1970	$ 1,024.00	$ 1,024.00	$ -0-
1970-71	53,611.00	53,611.00	-0-
1971-72	188,260.00	104,432.89	83,827.11
1972-73	660,204.00	262,374.00	397,830.00
1973-74	879,395.00	384,771.00	494,624.00
1974-75	663,706.00	434,994.00	228,712.00
1975-76	808,165.00	386,646.00	421,519.00

NUMBER OF FEET OF DUCT PRODUCED PER YEAR

YEAR	NUMBER OF FEET	NUMBER OF MILES
1970	22,500	4.26
1971	797,775	151.09
1972	2,095,678	396.91
1973	9,945,750	1,883.66
1974	12,365,600	2,341.97
1975	5,717,800	1,082,92
1976	10,537,975	1,995,83
	TOTAL MILES OF DUCT	7,856.64

That would be enough duct to go from Birmingham to Los Angeles, CA 3 times and enough left over to go from Birmingham to Montana.

PLAINTIFF'S EXHIBIT 42



VULCAN METAL PRODUCTS, Inc.

POST OFFICE BOX 4788 • 4N MOUNDALE INDUSTRIAL PARK • AREA CODE 205 591-2141 • BIRMINGHAM ALABAMA 35210

February 4, 1970

Memo #294

To: All Vulcan Salesmen

Subject: New Catalogs and Price Changes

Attached herewith are copies of mailing being made to all customers this week covering changes in General Catalog, effective February 15, 1970. You have already been sent copies of new Confidential Prices on the same material.

Separate mailing on Replacement Windqw materials only will be mailed direct to those customers presently using these materials. Attached is a supply of these sections for use with prospects. Therefore, most customers' General Catalogs will not have information in them regarding the replacement windows.

Also, we will mail out the complete new Roof Catalogs late this week or early next week. They will be completely new, with new binder, and will be loose-leaf type. You'll get your copies just as soon as they are available.

I would call to your attention that the attached mailing (1) gives all new pricing information (2) has a sheet for each section of the General Catalog to indicate changes, additions and deletions. You should make these changes in your catalog - and those you have for hand out to prospects - and you should make it a definite point on each call to customers to check their catalogs and make sure that they are up to date. As soon as we use up present supply of General Catalogs, we'll reprint them and incorporate these changes.

You'll note in Section B that we are deleting DE-18 storm door and all door hardware from Wright Brothers Company, among other changes.

You'll also note in Section F, Enclosures, that there are several new items such as PE-10 2" x 2" frame, woodgrain finish materials etc. Samples of these new items are en route to you now. Please note also that there is, in this mailing, a summary of the various types of enclosure materials we offer. IMPORTANT NOTE: You'll notice, on page F-3, attached that square foot costs are shown for each style enclosure. The prices shown on your copy attached are correct, but the same sheet was mailed out to customers had incorrect figures as far as square foot costs of PE-10 Enclosure are concerned. You'll have to correct these figures according to the attached, on your calls. That will give you a good chance to talk about this new system anyhow.

Memo #294

I am also attaching a detailed cost breakdown on each style of enclosure. These WERE NOT sent to customers. If you want additional copies, please advise.

Needless to say, you should make it a point to immediately study these changes, and if there are any questions, please advise.

Yours very truly,

VULCAN METAL PRODUCTS, INC.

Larry

Larry Hagood, Sales Manager

LH:ml

Enclosure

PRICE LIST - Effective February 15, 1970
(supersedes all previous price lists)
Prices subject to change without notic

SECTION F - VULCO ALUMINUM ENCLOSURES

CAT. NO.	DESCRIPTION	UNIT	PRICE
	NEW ITEMS		
PA-57-B	End clips for new style enclosure	Ea.	.055
PE-10	Screen frame, 2" x 2" x .040" with double spline and kickplate grooves. To use in lieu of 2 each 1" x 2" frames bolted together. Mill finish	Ft.	.45
PE-10-P	Same as PE-10 except painted white or silver (specify)	Ft.	.54
PE-10-WG	Same as PE-10 except painted in light green woodgrain finish	Ft.	.61
PE-5-WG	Regular 1" x 2" x .040" frame in light green woodgrain finish	Ft.	.406
PA-58-A-WG	2" x 2" x .040" expander in light green woodgrain finish	Ft.	.37
PA-58-B-WG	1" x 2" x .040" expander in light green woodgrain finish	Ft.	.244

CHANGES TO BE MADE TO CATALOG:

PAGE 7 change 116 plastic splines to read as follows:

Below stock sizes available in any quantity:

116-.125	116-.167 ribbed
116-.140	116-.235
116-.160	116-.250

All other sizes of plastic splines available, minimum order 25,000 feet.

DELETE THE FOLLOWING FROM CATALOG:

PE-[illegible]21	Expander - anodized
PE-22	Expander - anodized
562-A-B	Door Z-bar